AIRCRAFT & MISSILES

Chilton Publication APPLIED ENGINEERING FOR THE AEROSPACE INDUSTRIES March, 1960

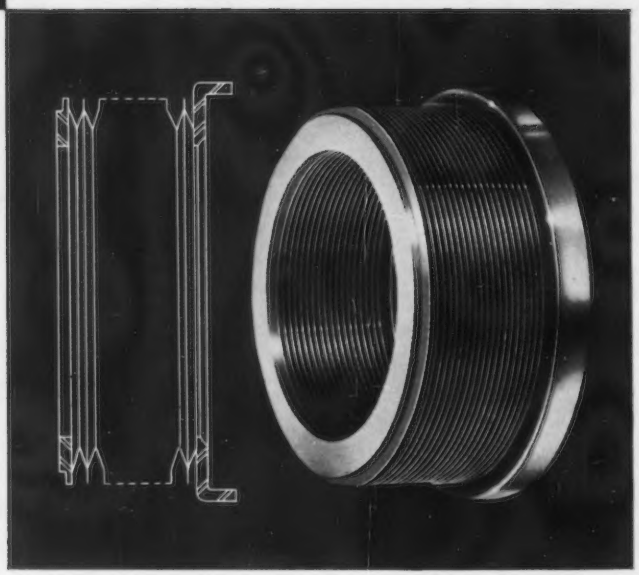
Missile Projects, Products, and Markets...P 33

AIRCRAFT SPECS . . . P 141 FUELS, ENGINES . . . P 125

"Stationary" Satellites For World Communications...P 26

C/R DESIGN NOTES

How C/R's New Metal Bellows Seal Meets Seemingly Impossible Operating Conditions



Operating Ranges

Temperature	−400° to 1000° F.
Pressure	500 psi
R.P.M.	80,000 plus

These known operating ranges indicate the function of this seal. It is designed for applications where temperatures and mediums to be sealed forbid the use of any organic materials. Typically, these applications include fuel pumps, compressor power units and turbine starters characteristic in rockets and missiles. Other applications include mechanisms which are exposed to a high level of radioactivity.

Design Advantages

The C/R metal bellows seal consists of a metal bellows — a welded homogeneous unit which is secured at one end — and a carrier ring in which the sealing face is mounted. The seal does not contact the shaft. It is stationary, and the only rubbing surfaces are the sealing face and mating ring. These surfaces are precision lapped to provide a positive seal with minimum friction. At any given pressure, the seal can be designed to maintain proper and constantly effective face loads. It orients immediately to run-out and will resist any torques it is subjected to in operation. The design has high end-play tolerance: Chicago Rawhide engineers have deflected a bellows .100 in. for three million cycles at 1750 cpm and at a temperature of 500° F. with no adverse effects.

A further advantage is relatively light weight and compactness. The C/R metal bellows seal can be designed for minimum axial and radial space. Axially, complete seals can be produced within a ¼ in. cross-section. Radially, dimensions are comparable with conventional end face seals.

The C/R metal bellows seal can also be designed with an extremely low coefficient of expansion. The importance of this factor becomes apparent with the fact that in many applications the operating temperature may change hundreds of degrees in a very few seconds.

Mediums To Be Sealed

Virtually any known liquid or gas may be positively sealed with this design, depending upon duration or service life. From a practical viewpoint, the C/R metal bellows seal is the best design for the sealing of cryogenic and high-energy fuels such as LOX, hydrogen peroxide, fluorine and other missile and rocket propellants.

Where possible, lubrication of the two sealing faces is desirable to prolong service life. However, the medium being sealed commonly acts as the lubricant and may be merely hot gas.

Materials

Sealing faces and mating rings for the C/R metal bellows seal are available in a variety of materials including carbons, carbides, ceramics and various alloyed metals for both high temperature and corrosion resistance. The bellows can be furnished in any of several metals and alloys such as stainless steel, Monel, Inconel X, Ni-Span C and other special alloy steels.

Consult C/R Engineers

Each application for the C/R metal bellows seal is essentially a custom-design and an intimate knowledge of all conditions to be encountered must be known by Chicago Rawhide engineers to produce the correct combination of properties in the seal. Then, whether you require five, fifty or five thousand seals, Chicago Rawhide will design and produce the correct seal to solve your problem.

Helpful Design Data:

We will gladly furnish you with a design guide and space envelope data concerning the C/R Metal Bellows Seal. Just write for Bulletin MBS-1 on your company letterhead.

CHICAGO RAWHIDE MANUFACTURING COMPANY

1303 Elston Avenue • Chicago 22, Illinois

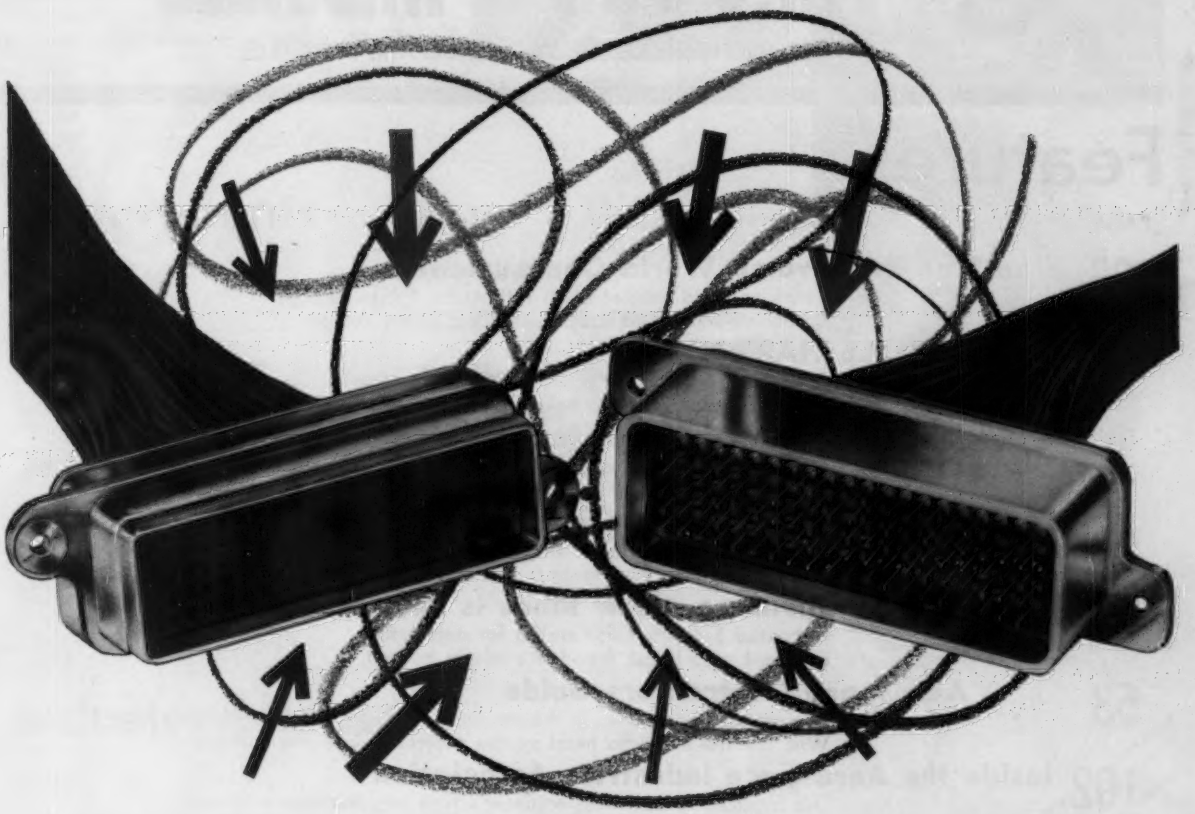
Offices in 55 principal cities

In Canada: Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario

Export Sales: Geon International Corp., Great Neck, New York

Circle 1 on Inquiry Card

WHEN THE DUTY'S ROUGH AND THE CIRCUITS ARE CRITICAL



***AMPin-cert* RACK AND PANEL CONNECTORS**—Here's a rack and panel connector that can really take a beating and keep right on going . . . performs like a champion in the toughest environments, with the roughest treatment yet gives enduring critical-circuit performance.

Environmentally sealed or unsealed, *AMPin-cert* connectors are made in 50 and 100 position units and have a number of unusual features including: single or dual circuit leads per contact (in the 50 position unit) . . . crimp-on snap-in contacts with extra wire insulation support against vibration . . . aluminum shells for shock . . . cadmium plating for corrosion resistance . . . extended alignment skirts plus alignment bushings on shells to prevent coupling damage to contacts . . . alpha-numerical coding of all cavities.

Get reliable performance under vibration and shock . . . in arid climates . . . in excessively humid conditions . . . in extreme cold or heat. No solder, naturally. Current rating of 5 amperes.

If you need a rugged connector with dry circuit sensitivity, the *AMPin-cert* Rack and Panel Connector is your answer. Send for more information today.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Japan

March, 1960 *Volume 3, Number 3*

AIRCRAFT & MISSILES

APPLIED ENGINEERING FOR THE AEROSPACE INDUSTRIES

Features

PAGE

26 **The Plan To Revamp World Communications**
Satellites could blanket Earth with radio, TV, telegraph; Launching rockets already exist; Cost within reason

33 **1960 MISSILE HANDBOOK**
Sixty-four pages, each packed with engineering and sales information to help you do aerospace business in 1960

36 **Missile Directory and Data**
Design, performance, and contractor data for 58 missiles in production or receiving major funding

46 **Missile and Space Programs**
A descriptive list of over 120 missiles and space projects now in research or advanced development

51 **Defense Spending—How Much Is Enough?**
Estimated $14.675 billion slated for aerospace; Congress may boost President's missile budget

53 **Aerospace Contractors Guide**
Who are the companies in the aerospace industries? What do they make? Who are the men who head up the projects? Get the answers.

102 **Inside the Aerospace Industries Association**
This planning group saves engineer's time and taxpayer's money; How this is done is explained by example

115 **Guidance—A Summary Report**
An elementary analysis of the various guidance schemes in use; List of some major manufacturers is included

125 **Jet and Rocket Powerplants and Fuels**
The "big push" in the space race will be provided by rockets now in design and development, details given

141 **1960 AIRCRAFT HANDBOOK**
Specifications and performance data on leading military, civil, and commercial aircraft

Staff

GEORGE T. HOOK, Publisher
W. THOMAS H. MacNEW, Editor

EDITORIAL

JOHN P. KUSHNERICK, Managing Editor
S. PETER KAPRIELYAN, Technical Editor
HARRY CASTERLIN, Art and Editorial Production Mgr.
PETER R. SIGMUND, News Editor
MARCUS AINSWORTH, Statistical Editor
HAROLD M. NELSON, Specifications Editor
HOWARD KOHLBRENNER, Art Director
ROBERT GUNNING, Readability Consultant
HARRY R. KAUCK, Technical Illustrator

REGIONAL and FOREIGN EDITORS

Los Angeles—J. PHILIP GEDDES, Technical Editor, West Coast
Detroit—JOSEPH GESCHELIN, Technical
HUGH C. QUINN, News
Washington—GEORGE H. BAKER, Chief
NEIL R. REGEIMBAL, News
RALPH W. CROSBY, News
Washington Member, Editorial Board—PAUL WOOTON
Europe—RONALD A. COLE

BUSINESS

BENNETT H. HORCHLER, Assistant Publisher
E. H. MILLER, Advertising Manager
JAMES CADAGAN, Circulation Manager
JOHN H. KOFRON, Director of Research
NORMAN M. LLOYD, Marketing Manager
JOHN H. DAVIS, Marketing Research

REGIONAL SALES MANAGERS

Atlanta—JOHN W. SANGSTON
911 Wm. Oliver Bldg., 32 Peachtree St., N.E.
JAckson 3-6791
Chicago—RICHARD P. McCLANAHAN
360 N. Michigan Ave. RAndolph 6-2166
Cleveland—ROBERT COBURN
930 B. F. Keith Bldg. SUperior 1-2860
Dallas—WILLIAM J. SMYTH
Meadows Bldg. EMerson 8-4751
Los Angeles—JACK KAY
198 S. Alvarado St. DUnkirk 7-4337
New York—TED DRISCOLL
100 E. 42nd St. OXford 7-3400
Philadelphia—GEORGE ISHERWOOD
Chestnut & 56th Sts. SHerwood 8-2000
San Francisco—DON MAY
1355 Market St. UNderhill 1-9737

THE COVER STORY

In the light of our future needs, present long-distance communications are as inadequate as our bulging highway networks. Depicted in this month's cover is a solar-powered communications satellite in an equatorial 24-hr orbit around the Earth. From 22,290 mi in space, a minimum of three such satellites would foster a new era in world-wide communications. (Page 26)

Departments

PAGE

7 Editorial

9 Reader's Orbit

11 Data Capsule

20 Your Datebook

100 New Books and Reports

152 Worth Asking For

PAGE

153 New For Production

155 New Materials

158 New Electronic Products

160 New Parts and Components

163 Men on the Move

Industry Notes

PAGE

165 British Aircraft Groups Form

165 NASA Space Vehicle Plan for Decade

165 Contracts

166 President Proposes Space Act Changes

167 R & D Briefs

PAGE

171 Production Techniques

172 A Researcher's View of Global Communications

174 New Facilities

175 Aerospace Log

176 Business Moves

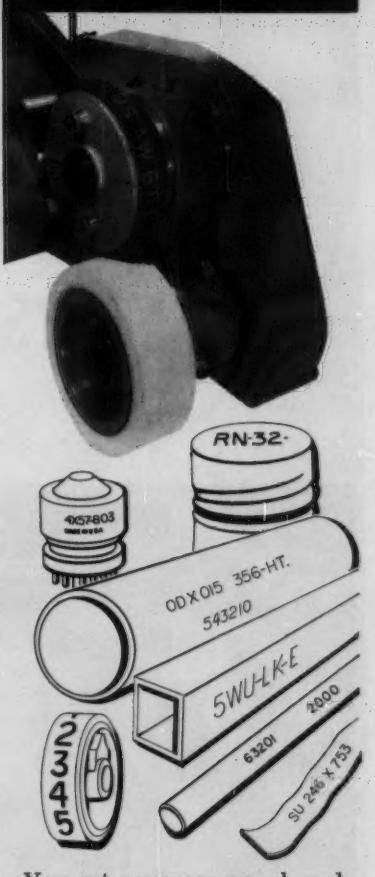
CHILTON COMPANY, OFFICERS AND DIRECTORS:
President. G. C. BUZBY
Vice Presidents
P. M. FAHRENDORF
LEONARD V. ROWLANDS
GEORGE T. HOOK
ROBERT E. McKENNA
Treasurer: WILLIAM H. VALLAR
MAURICE E. COX
EVERIT B. TERHUNE, JR.
FRANK P. TIGHE
RUSSELL W. CASE, JR.
CHARLES A. S. HEINLE
JOHN H. KOFRON
Comptroller: STANLEY APPLEBY

Editorial and Executive Offices: Chestnut and 56th Sts., Philadelphia 39, Pa. SHerwood 8-2000.

BPA

Accepted as controlled circulation publication at Philadelphia, Pa. Copyright 1960 by Chilton Company. Published monthly. Subscription rates: United States and Canada, $10.00 per year. Single copies $1.00, special issues $2.00. Foreign $20.00 per year—single copies $2.00, special issues $3.00 per copy.

MATTHEWS
INDUSTRIAL OFFSET PRINTERS
Speed Production



You get economy, speed, and the highest quality marking on your products with a Matthews Offset Printer adapted for *your* product, and designed for *your* production.

Printers may be installed to print shapes, sheets, bars, extrusions, wire, etc., with the proper inks for metals, plastics and fabrics.

Write today, stating your marking requirements.

JAS. H. MATTHEWS & CO.
3962 FORBES AVENUE
PITTSBURGH 13, PA.

Circle 5 on Inquiry Card

Before Buying Ultrasonic Cleaning Equipment

GET A FREE ULTRASONIC CLEANING ANALYSIS

To show you . . . at no cost . . . how ultrasonic cleaning equipment fits into your operation, National Ultrasonic Corporation now offers you a free ultrasonic cleaning analysis. An Applications Laboratory is maintained in which your sample parts are cleaned by specialists and returned within two weeks of their receipt together with the equipment and cleaning agent recommended for your particular application and their costs.

For your ultrasonic cleaning requirements, National Ultrasonic Corporation provides:

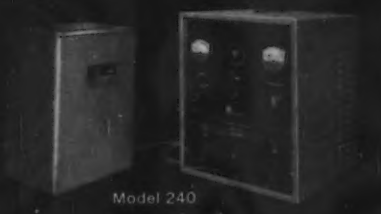
- Two lines of cleaners which cover the complete range of ultrasonic cleaning equipment through extremely high power units.
- NUclean® solvents and detergents, especially formulated for ultrasonic cleaning.

STANDARDLINE for all applications requiring average energy levels

Model 100

Model No. (115 volts A.C. 1 phase 60 cycle)	Capacity (gallons)	Power Output (watts) Average	Peak	Inside Tank Dimensions (in.) Length	Width	Depth	Crystal Radiating Surface (sq. in.)	% of bottom covered with crystals
100	1	60	240	9¼	5	6	12	25
120	2	125	500	10½	8½	6	24	27
140	7	250	1000	14¾	11¾	10	48	27.5
160	13	500	2000	20	16	10	96	30

HEAVYDUTYLINE for industrial applications requiring high energy density



Model 240

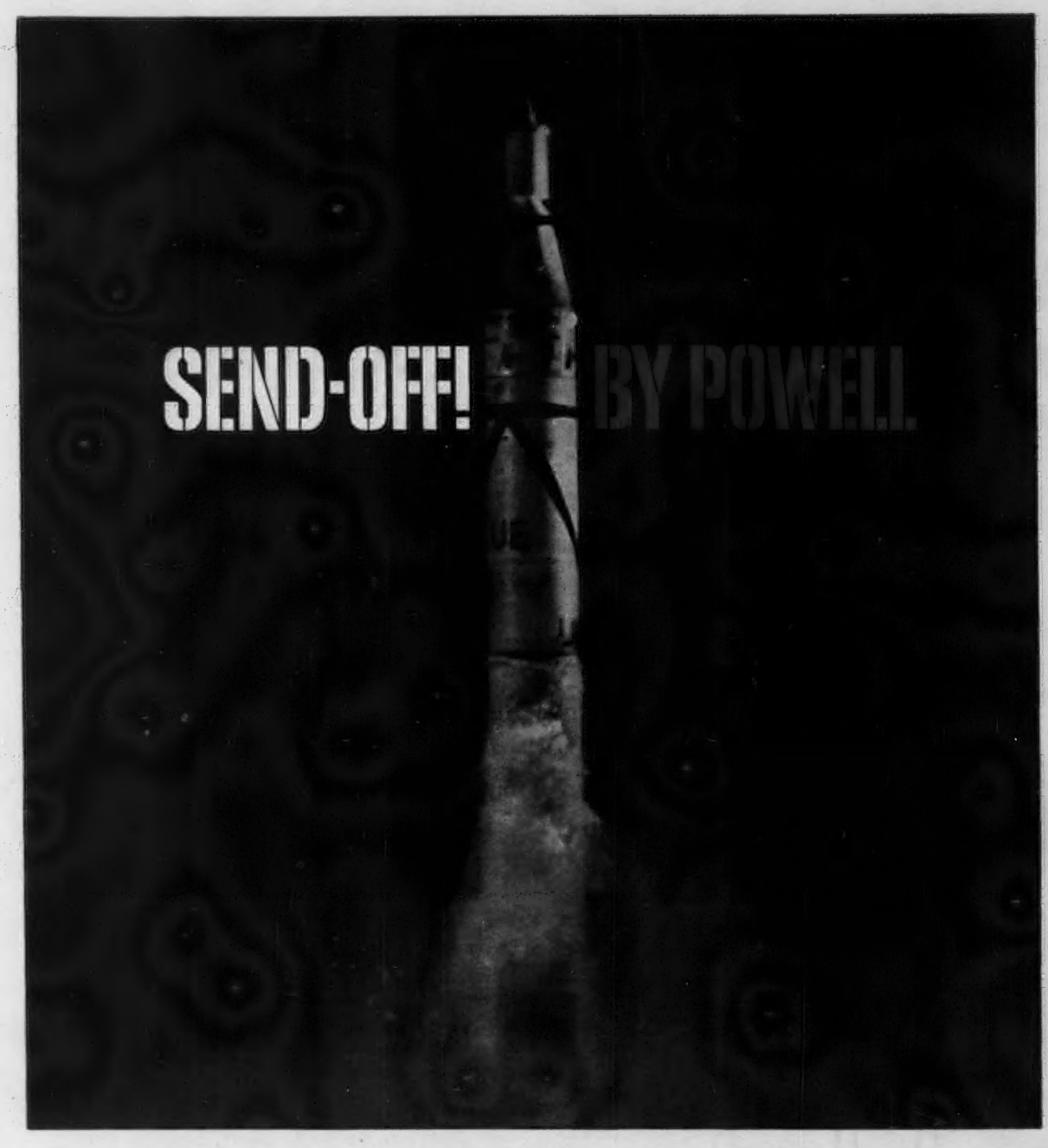
Model No. (115 volts A.C. 1 phase 60 cycle)	Capacity (gallons)	Power Output (watts) Average	Peak	Inside Tank Dimensions (in.) Length	Width	Depth	Crystal Radiating Surface (sq. in.)	% of bottom covered with crystals
200	1	60	240	7	4	7	12	43
220	2	125	500	9	6	10	24	44.5
240	5	250	1000	12	9	12	48	44.5
260	12	500	2000	16	12	16	96	50

WRITE FOR COMPLETE INFORMATION

National Ultrasonic corp.

111 Montgomery Ave., Irvington 11, N. J.

ESsex 1-0550 • TWX NK 1030



Powell Valves control the flow of the propellant fuels in storage and into the missile.

Powell engineers and metallurgists have met this newest valve challenge of our time—by perfecting precision, flawless, never-failing valves for the ground support equipment of our Nation's guided missiles and rockets.

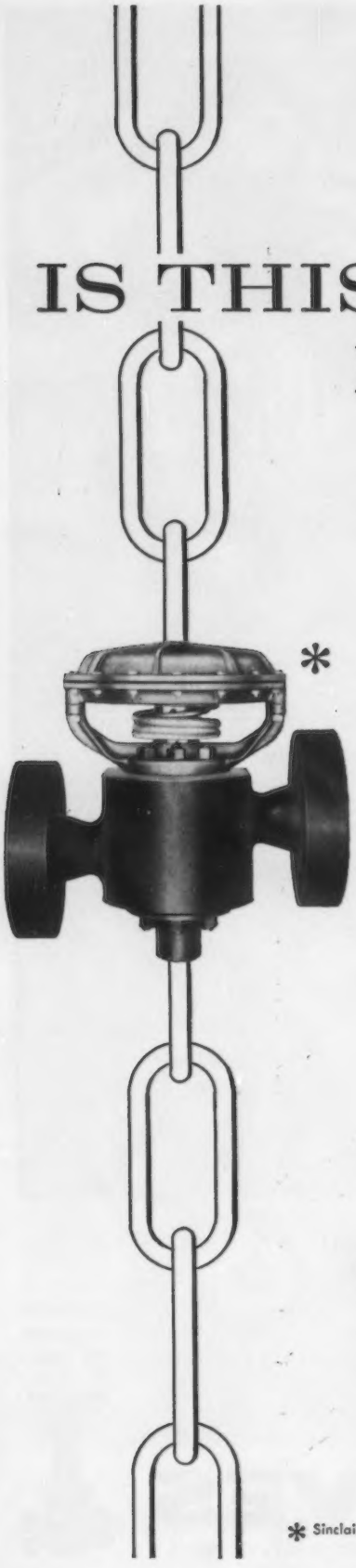
Since 1846, the Wm. Powell Company has been manufacturing vital valves to fill the needs of all industries and reach brave new worlds.

You can count on Powell Valves at the "count-down" in **your** industry for handling water, oil, gas, air, steam, corrosive fluids, or fuels. Contact your nearest Powell Valve distributor. And for complete information on Powell Valves in the United States missile program, write directly to us.

world's largest family of valves

POWELL VALVES

THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO



IS THIS* THE MISSING LINK?

Do your plans for wind tunnel, test or ground support equipment include a requirement for control of air at high pressures up to 5000 psi?

Here's the answer. Sinclair-Collins' diaphragm-operated high pressure control valves offer fast and positive control, bubble-tight sealing, compact size and ample safety factors. Bodies are machined from stainless or molybdenum steel billets for strength and corrosion-resistance . . . stems are stainless steel, with Stellited seating surfaces for maximum life and resistance to wire drawing or cutting.

Available sizes range from ½ to 2 in. NPT; screw, flanged or butt welding ends; 2-way normally open or normally closed; for direct or remote electro-pneumatic control. Your Sinclair-Collins Field Engineer can make specific recommendations.

For more information, write for free Bulletin HPA. Address: Sinclair-Collins Valve Company, Akron 9, Ohio, Dept. AMM-360

The SINCLAIR-COLLINS VALVE Co.

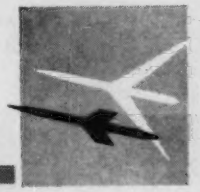
AKRON, OHIO

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

Other INDUSTRIAL DIVISIONS of IBEC: The Bellows Co., Akron, Ohio · Valvair, Akron, Ohio · V. D. Anderson Co., Cleveland, Ohio

* Sinclair-Collins 5000 psi air control valve.

8116



EDITORIAL

The Pathetic Apathy About National Defense

Everyone is sounding off about our national defense. The President says one thing, based on advice from Secretary Gates and the Chairman of the Joint Chiefs; Armed Forces generals seem to have other ideas. The public is split three ways—defense adequate, defense inadequate, and who cares. Maybe, we're trying to kill "the bear" by having him laugh himself to death.

What's the real truth? No one is sure. Why? Simply, we haven't had the opportunity to look over Russia's military might first hand. We can only surmise or make educated estimates based on reliable, we hope, military intelligence.

The problem is clearly developing into a political issue. Now, whom will the public believe, and will that political party have the right answers? A wrong step here could place us in further jeopardy, the right step could help the situation. Also, we must do something, pre-election, about the "who cares" faction of American people.

For the sake of our country and the people, we make an urgent request. You, of the aerospace industry, should have a better understanding of U. S. defense problems than Mr. John Q. Public. Now is the time to speak up.

Express yourself on defense policies. Talk it over with fellow workers, employees, friends, and family. Above all, tell your elected representatives how you feel about our defense effort.

Industry has to take a hand in helping legislators reach decisions. It's not a one man job. Everyone has to take part whether he is on the drafting board or in top management.

Remember, tell the people who can do something about our defenses. Don't gripe after election for something you failed to do now. We MUST educate voters so responsible people, whether Republicans or Democrats, will be put in office to govern the defense policies of the crucial years ahead.

Don't start thinking about it in November. Now is the time.

Tom MacNew

Editor

As a public service, a form letter is provided on the next page. You can aid your country and your legislators by completing the letter with typewriter or ballpoint pen, and mailing it to the address shown. Additional copies can be obtained by writing to the Editor, Aircraft & Missiles.

A STATEMENT OF PUBLIC OPINION ON DEFENSE POSTURE

The Hon. Lyndon B. Johnson, Chairman
Committee on Aeronautical and Space Sciences
United States Senate
Washington 25, D. C.

Dear Senator Johnson:

Realizing that public opinion is vital in the decisions you make, I am forwarding my comments on the much talked about "missile gap" and "space lag." I hope they will be of some benefit to your committee's current study.

I feel the present missile and space programs are inadequate. My reasons for this, and a suggested course of action are as follows:

I feel the present missile and space programs are adequate. My reasons for this are as follows:

I am fully aware that an increase in defense spending beyond the President's proposed $4 billion budget surplus for fiscal 1961 could result in increased taxes.

Respectfully yours,

Name:

Address:

Occupation:

Reader's Orbit

D's & Q's

I became exposed to a copy of your magazine today for the first time, and browsed through it at the suggestion of a friend. Needless to say, the article on the Radiation Damage and the article covering Throw-Away Electronics hit home with a resounding smash, inasmuch as our group is currently in the throes of "shoe-horning" some 2,000 Q's, D's, R's and C's into a memory device which will cast into orbit sometime in the future.

This expose convinced me that I need a subscription to A&M coming to my attention *every* month, so I would appreciate very much your adding my name to your rolls.

As a deSeversky disciple, I heartily endorse the fit of rage which stimulated the January editorial.

Walter G. Loyte
Reliability Engr.
Laboratory For Electronics Inc.

Involved in Radiation

. . . Since we are getting more involved in nuclear radiation in the Packing and Gaskets field, and need all the information we can get, would it be possible to send us one or two copies of (the nuclear articles from the December issue) . . . it would help us considerably.

K. M. Lowe
Johns-Manville
Sales Corp.

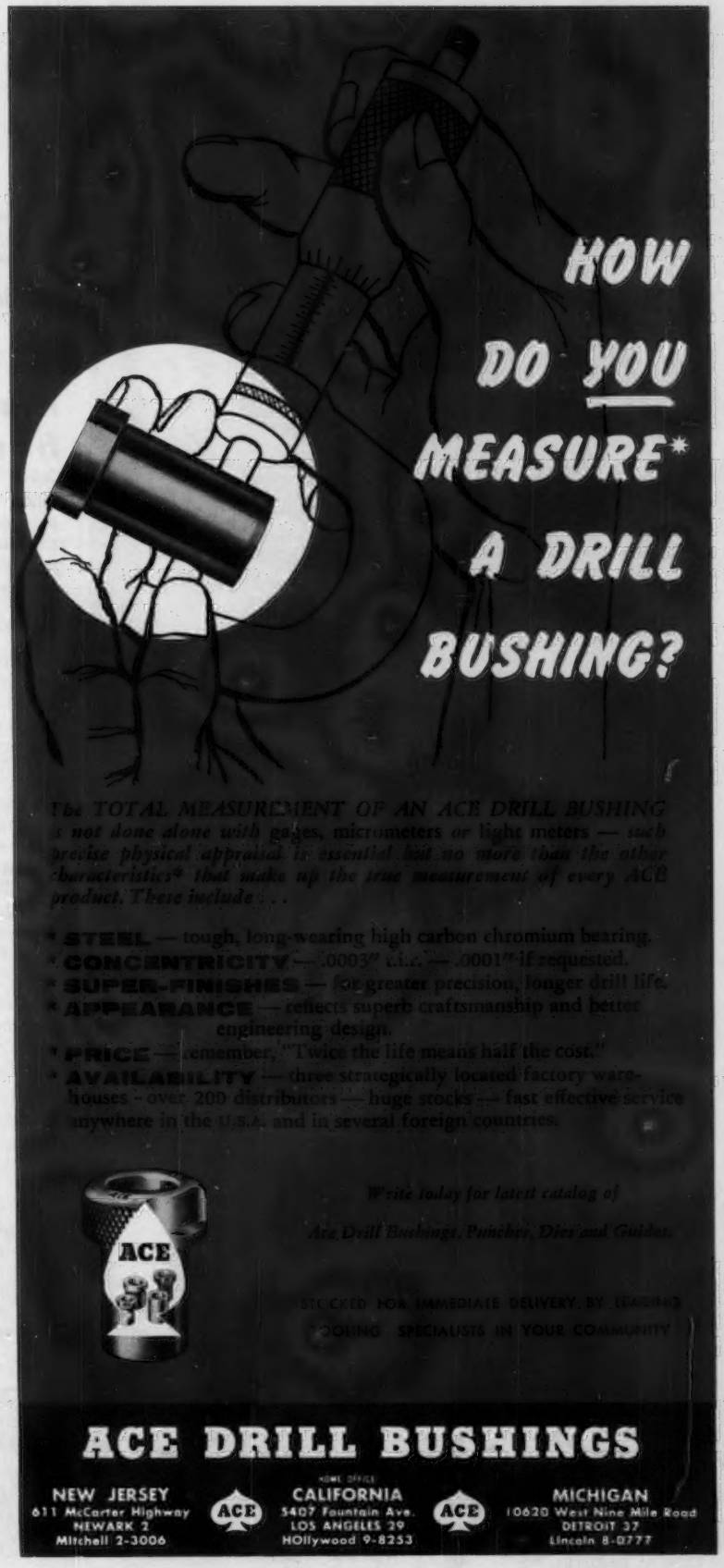
It would not only be possible, it would be a pleasure.

Credit Due

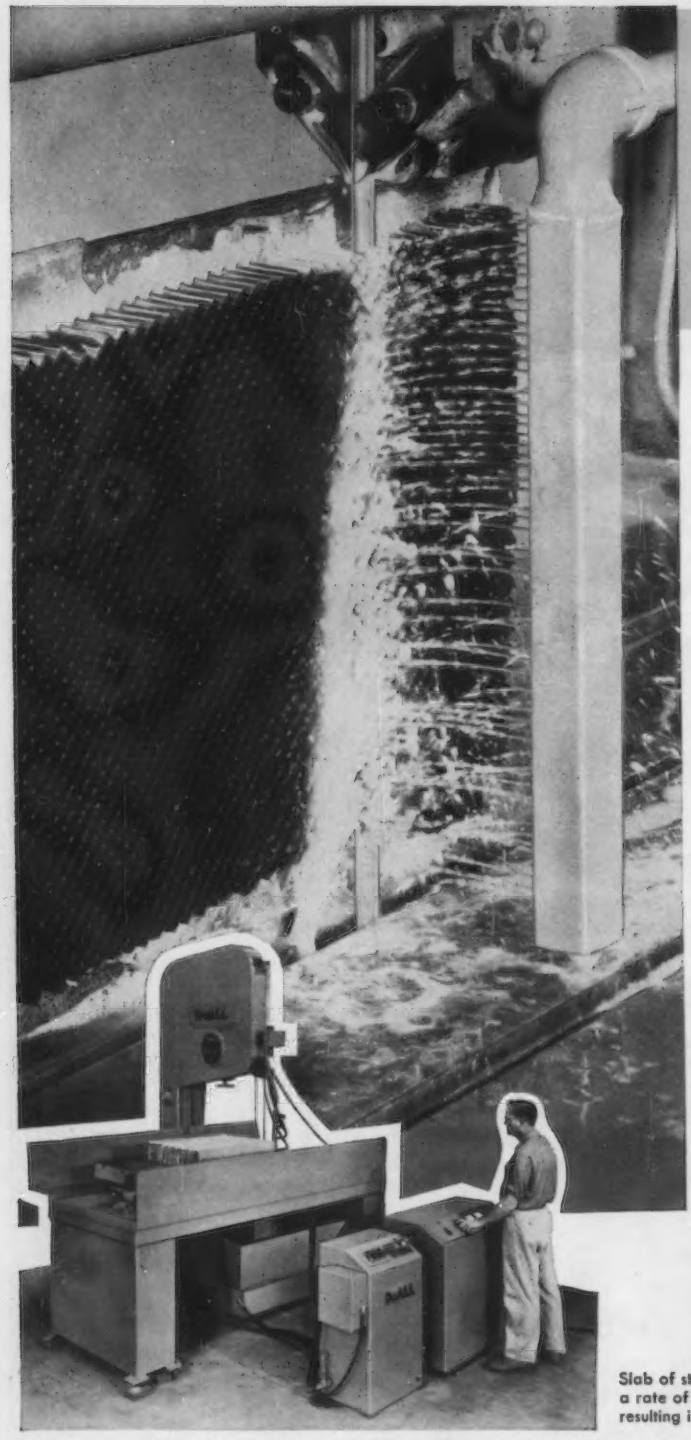
I appreciated your treatment of my article on "Optical Synchro System," which appeared on pages 42-44, January issue.

However, for the record, it should be pointed out that the individual mainly responsible for the development of this system is Dr. J. G. Gievers, Advanced Development Branch, Chrysler Missile Div. Credit for Dr. Gievers was included in my article, but was left out of the final story.

Robert O. Wyne
Weapons System Manager
Advanced Projects Organization
Chrysler Corp.


HOW DO YOU MEASURE* A DRILL BUSHING?
The TOTAL MEASUREMENT OF AN ACE DRILL BUSHING is not done alone with gages, micrometers or light meters — such precise physical appraisal is essential but no more than the other characteristics* that make up the true measurement of every ACE product. These include . . .
• STEEL — tough, long-wearing high carbon chromium bearing.
• CONCENTRICITY — .0003" T.I.R. — .0001" if requested.
• SUPER-FINISHES — for greater precision, longer drill life.
• APPEARANCE — reflects superb craftsmanship and better engineering design.
• PRICE — remember, "Twice the life means half the cost."
• AVAILABILITY — three strategically located factory warehouses - over 200 distributors — huge stocks — fast effective service anywhere in the U.S.A. and in several foreign countries.
Write today for latest catalog of Ace Drill Bushings, Punches, Dies and Guides.
STOCKED FOR IMMEDIATE DELIVERY BY LEADING TOOLING SPECIALISTS IN YOUR COMMUNITY
ACE
ACE DRILL BUSHINGS
NEW JERSEY
611 McCarter Highway
NEWARK 2
Mitchell 2-3006
ACE
HOME OFFICE
CALIFORNIA
5407 Fountain Ave.
LOS ANGELES 29
HOllywood 9-8253
ACE
MICHIGAN
10620 West Nine Mile Road
DETROIT 37
Lincoln 8-0777

Circle 9 on Inquiry Card



DoALL announces ELECTRO BAND MACHINING*

...a new and better means for slicing honeycomb metals

With this new development DoALL has solved one of the most irksome machining problems—that of cutting and producing fine finish on honeycomb of aluminum, stainless steel or titanium foil as well as other thin-wall metal structures such as heat exchanger cores.

Electro-Band Machining is an extension of the band sawing technique. A modified DoALL band machine uses a special saw band which is energized with low-voltage, high-current electric power.

QUENCHED ARC CUTTING

As the saw edge moves into the metal, an electric arc melts the thin sections while a flood of water quenches the arc and limits the heat. Resulting finishes can be attained to a flatness range of plus or minus .003 in. T.I.R. or plus or minus .016 in. T.I.R., depending upon cutting rates which range from 5 to 200 sq. in./min.

With Electro-Band Machining you can now start with a "log" and slice off pieces to accurate dimension and final finish rapidly and at low cost. The need for grinding core flat can be eliminated.

Electro-Band Machines are available in three sizes to accommodate work ranging from 12 to 48 in. in thickness. Insulated worktables are hydraulically operated; table feed rate and voltage to the cutting band are variable to meet job requirements.

For further details, call your local DoALL store or write for literature.

Slab of stainless steel honeycomb is cut to 5/16 in. thickness at a rate of 50 sq. in./min. The flood of water confines arcing, resulting in a finish equivalent to that produced by grinding.

*Patent applied for.

B-62

THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

Data Capsule

SUMMARY OF MANAGEMENT TRENDS AND TECHNICAL DEVELOPMENTS IN THE AEROSPACE INDUSTRIES

MISSILES AND SPACE VEHICLES

Design

THOR RANGE has been increased by a light-metal low-drag fairing remaining over the Mark II nose cone during early flight. This "exit vehicle" increases Thor height by eight ft.

STORABLE FUELS FOR ATLAS are under study. Convair now considers LOX storable, has submitted proposal to Air Force to develop system for use in hard bases. Atlas would be modified only slightly.

NEW AGENA ENGINE is slated to stabilize Midas satellites in flight, fire them into orbit, and change orbital path. Manufactured by Bell under subcontract to Lockheed, it has potential for placing synchronous communications satellites above the equator, using existing launch sites.

Development

TITAN SECOND STAGE flight Feb. 2 used 80,000-lb-thrust engine developed by Aerojet-General. Stage was 41 ft long, weighed 24 tons. Largest previous liquid-fueled upper stage had 15,000 lb thrust.

SKY BOLT DEVELOPMENT has received official go-head. Douglas will prime the air-launched missile project.

SATURN DEVELOPMENT received a boost in regular and supplementary budget requests. Program is expected to be funded for about $240-million in FY 1961. Clustered first stage may be flight-tested next year. Three stage version, designated C-1, is now expected to become operational in 1964.

COMMAND-WIDE REORGANIZATION of ARDC aims at improved weapons system management. Four revamped divisions are: Ballistic Missile Div. (missiles); Command and Control Development Div. (electronics and control); Research Div. (basic research); and Wright Air Development Div. (aircraft).

IMPROPER VALVE FUNCTIONING is blamed for five failures in Bomarc B launchings. House Defense Appropriations Subcommittee has disclosed that Bomarc A destroyed only one supersonic target in ten test shots.

NEW ICBM BASES are big items in 1961 budget. Second Atlas base becomes operational next month near Warren AFB, Wyoming. First Titan bases are being built at Vandenberg AFB and Lowry AFB.

ATLAS AND TITAN MERITS are being debated amid charges of duplication. Atlas potential range is now reported equal that of Titan, i.e., over 8500 mi. Titan was designed for a larger warhead, but larger Atlas nose cone is also being developed. Defense Secretary Gates gives the nod to Titan in storable fuel potential. At least one Atlas has carried a Titan nose cone.

Production

NIKE ZEUS production won't be okayed until Pacific tests show anti-ICBM system is effective. About $137-million in production funds is being held up.

WEIGHT-SAVING on Rocketdyne's main stage engine for Atlas reached 25 per cent through use of filament-wound wrap. Hoop tensile ratio strength is 1,400,000

psi. Firm has reportedly doubled this strength for reinforced plastics using poly-glass crystal structures. The higher strength wrap is expected to be available for production use in a year.

Procurement

TOP MISSILE ITEMS in Fiscal '61 procurement: Saturn R & D; Mercury, $123-million; Hound Dog production, $170-million; Nike Zeus tests, $300-million; Sky Bolt R & D, $60-million; Dyna-Soar R & D, $52-million; Mace production, $39.8-million; large sums for Minuteman facilities, Polaris subs and missiles, Atlas and Titan bases and squadrons.

CHIEF SERVICE PURCHASES: Army, Hawk, Sergeant, Lacrosse, Little John, first Davy Crocketts (SSM) and Redeyes (SAM); Navy, Sparrow III, Sidewinder, Polaris; Air Force, Hound Dogs, Quails, 13 Atlas and 14 Titan squadrons.

MOLDED-RUBBER ROCKET LINERS are being produced for Minuteman third stage. Goodyear makes them from synthetic rubber 0.1 to 1.2 in. thick.

AIRCRAFT

Design

SMALL VTOL AIRPLANE being tested at Lockheed's Georgia Div. is turbojet-propelled. An ejector augments thrust for takeoff and landing.

"FLYING WING" has been designed by Vertol engineers to extended helicopter range beyond 2000 mi. Device is a wing-shaped fuel tank that is towed behind helicopter.

NEW STABILIZING SYSTEM simplifies hovering of light helicopters. Developed by Autonetics Div. of North American, it weighs less than 9 lb; uses rate gyros as primary component.

REAR-ENGINE LAYOUT in the Vickers VC10 commercial jet aims at effective use of high-lift devices on wing. By putting engines in tail, Vickers will be able to fly 38,000-lb payload from 6000-ft runways.

NOSE-GEAR LAUNCH SYSTEM will be incorporated on the Grumman W2F, which joins the fleet this year. Most catapult-connecting gear is on the plane instead of the carrier. The Naval Air Material Center, developer, says system reduces launching intervals from 40 to 25 sec.

NEWEST DC-8 JETLINERS are called fastest U. S. transcontinental transports. Approved cruise speed is Mach 0.88. Takeoff and landing speeds are kept low through use of 30-deg. speed-back wing, and installation of slots on leading edge of each wing. DC-8 now has Sperry SP-30 automatic flight-control system.

Development

NEW DUTCH WIND TUNNEL is being made available to European aircraft manufacturers excluding those of Britain. Arrangement is through AICMA, a group aiming at coordinated aircraft development. Tunnel can be used for Mach 1.3 speeds.

GAMMA-RAY FUEL GAUGE will be tested by the Navy. It uses radiation sources, such as Cobalt-60, mounted on sides of each tank. Detectors measure intensity of rays after they pass through fuel supply.

SPEEDS EXCEEDING 1500 MPH may be reached by Bristol's T-188. The welded stainless steel aircraft makes its first flight this year.

PHOTOSCAN AERIAL RECONNAISSANCE system is reportedly being considered for a photo version of NAA's A3J.

Production

TITANIUM CASTINGS can now be made on a production scale for aircraft. Process was developed by Manufacturing Methods Div., Aeronautical Systems Center, Dayton, O.

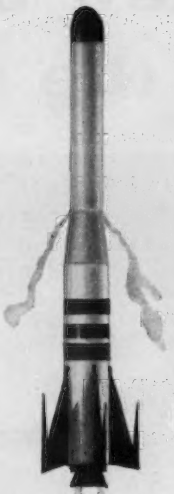
FIRST PRODUCTION T-39 SABRELINER is scheduled to roll off the assembly line this Spring. Air Force has ordered 42 of the utility trainers from NAA's Los Angeles Div.

Procurement

1961 BUDGET proposes 1510 new military aircraft. Navy would receive 658; Air Force 633; and Army 219.

CIVIL AGENCIES of U. S. government will purchase 37 new aircraft at a cost of $21 million in FY 1961.

COUNTDOWN at PESCO



The "Countdown at Pesco" begins in laboratories far from the launching pads. It begins with teams of resourceful Pesco engineers . . . men of vision eminently qualified to meet the technical challenges and rigid reliability requirements of the aerospace industry. All Pesco products shown at right are now critical components of operational air weapon systems. These components are the products of Pesco's advanced engineering that anticipates the sophisticated requirements of the industry . . . plus Pesco's proven capacity for precision production to meet customer delivery schedules. Investigate Pesco's capabilities before you specify on your next project.

PESCO PRODUCTS DIVISION
BORG-WARNER CORPORATION
24700 North Miles Road • Bedford, Ohio

EXPORT SALES: Borg-Warner International Corporation
36 Wabash Avenue, Chicago 3, Illinois

Contact your nearest Pesco Sales Office or write direct for private showing.

This new 20-minute full color film enables you to evaluate firsthand Pesco's research, development and production capabilities.

8700-PC

Everything new but the shape

Ever since man discovered the wheel, he has been working at new ways to use it. The latest use of the wheel is in the jet turbine. These turbine wheels and compressor wheels, forged in massive closed dies from materials unknown a few years ago, make possible the outstanding performance records of our American engines.

Helping wheels turn—on the ground—on the sea—in space—is all part of Wyman-Gordon's business. Where performance depends upon stamina, there is no substitute for a forging—and in a forging there is no substitute for Wyman-Gordon experience, quality and dependability.

WYMAN-GORDON

FORGINGS

of Aluminum Magnesium Steel Titanium . . . and Beryllium Molybdenum Columbium and other uncommon materials

HARVEY ILLINOIS WORCESTER MASSACHUSETTS DETROIT MICHIGAN
GRAFTON MASSACHUSETTS FRANKLIN PARK ILLINOIS LOS ANGELES CALIFORNIA FORT WORTH TEXAS

This concept of man's attempt to harness bird power in an attempt to fly first appeared in "The Man in the Moon" — published in Paris in 1648. In 1659, the same mode of air travel was depicted in another book, "The Flying Wanderer." Here, Brussel-Smith, noted graphic artist, has interpreted the original drawing through the medium of wood engraving.

IMAGINATION IN SPACE

Since Creation, man has looked out on space. At first, unknowing and incurious; then with the beginnings of understanding; now free and able to explore. Yet to move in space calls for wholly new concepts of energy.

This, then, is the working philosophy of Hercules in chemical propulsion: To design and manufacture highly concentrated packages of energy as propellants and rocket motors; each compatible, controllable, predictable; and each perfected for its specific mission.

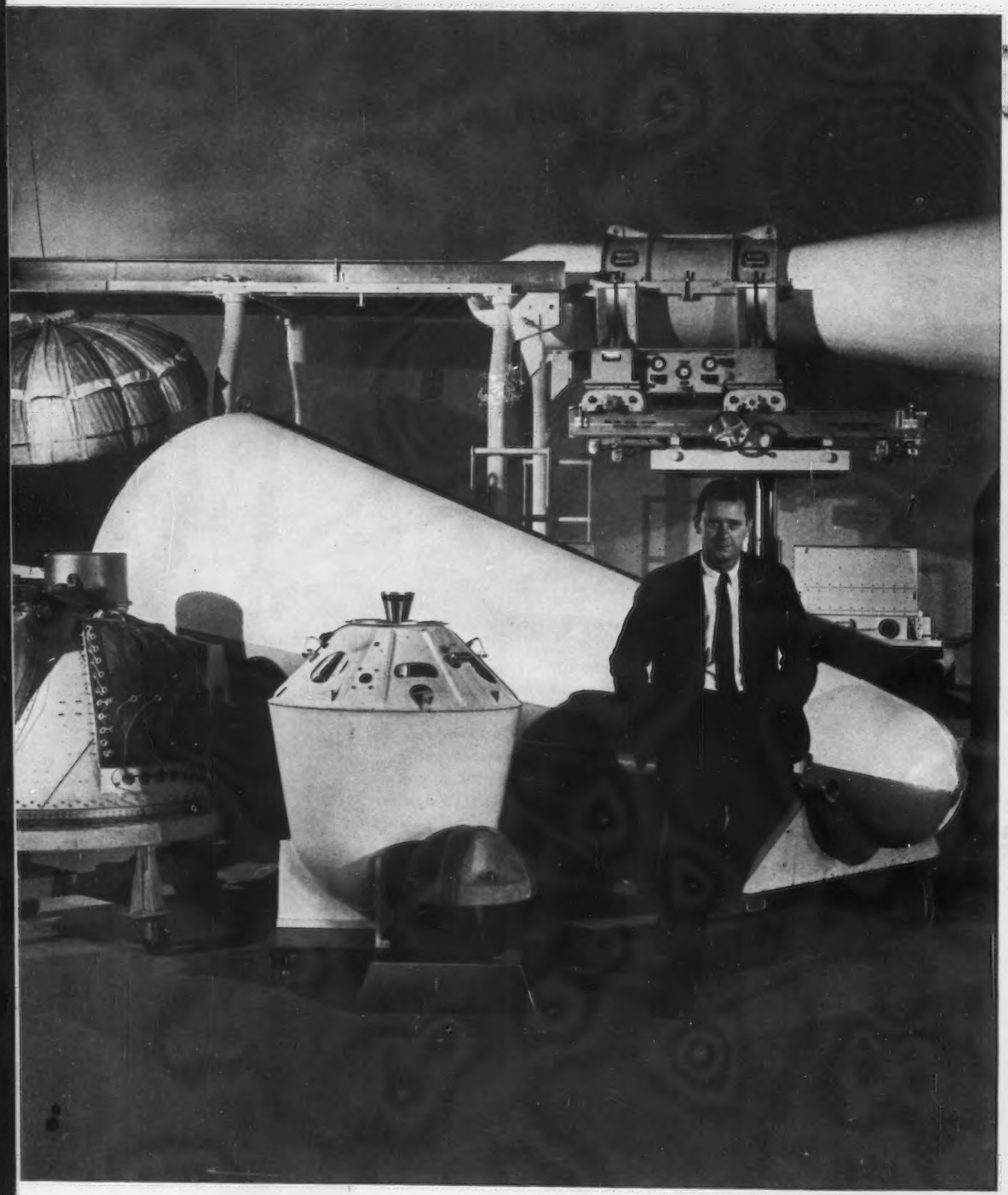
HERCULES' BACKGROUND: A half-century of creative imagination in the evolution of propellants, from shotgun powder to the manufacture of every one of the millions of U. S. rockets fired during World War II, and now to space propulsion. Hercules facilities today encompass research, design, engineering, and staff organization for the production of the most advanced propellants. Illustrated brochure available on request.

HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

XP59-2

Circle 13 on Inquiry Card

4000 subcontractors are represented re-entry vehicle "family portrait"



in this unique dramatizing . . .

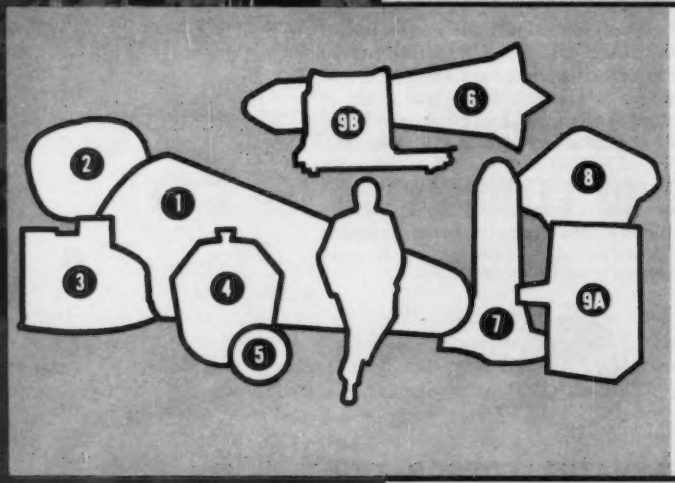
4 years of USAF, G.E., SUBCONTRACTOR re-entry vehicle progress

The key to this progress has been teamwork . . . teamwork between General Electric's Missile and Space Vehicle Department, the Ballistic Missile Division and the Ballistic Missile Center of the United States Air Force and the over 4000 small and large subcontractors alike who have helped MSVD make so many vital contributions to U.S. re-entry vehicle progress.

IN 1959 ALONE, the following figures indicate the emphasis MSVD placed upon this important factor of subcontractor teamwork on Air Force projects.

- Over 35,000 different purchase orders were placed by MSVD on subcontractors in 1959.
- More than 25,000 of these MSVD purchases were made from "small" subcontractor businesses.
- More than $26,000,000 worth of goods and services were purchased by these 35,000 orders. This amount represented a major portion of the contract dollars received by MSVD.
- And more than $13,000,000 of this $26,000,000 went to "small" business firms.

If you'd like more information about G.E.'s Missile and Space Vehicle Department . . . its subcontracting activities, its re-entry vehicle programs or about any of its space technology activities . . . write to Section 160-70, G.E. Missile and Space Vehicle Department, 3198 Chestnut Street, Philadelphia 4, Pa.



Mr. Hilliard W. Paige, General Manager, Missile and Space Vehicle Department with Air Force re-entry vehicles developed by MSVD.

1. RVX-2 Re-entry/Recovery Vehicle, the largest ablation-type re-entry vehicle to travel full ICBM-range and be recovered.
2. Flotation balloon used in recovering USAF-MSVD research re-entry vehicles.
3. Recovery equipment package for RVX-2.
4. Satellite Aeromedical Re-entry/Recovery Vehicle for USAF Discoverer Program.
5. Mark-2 recoverable Data Capsule which flew in Thor re-entry vehicle and returned first films from outer space.
6. Mark-3, an advanced operational-type re-entry vehicle for Atlas.
7. RVX-1, first ablation-type re-entry vehicle to be recovered after full ICBM-range flight.
8. Mark-2, first U.S. operational heat-sink re-entry vehicle now in use on USAF Thor and Atlas missiles.
9. Typical ground support equipment developed by MSVD for USAF use. (A) Mark-2 prelaunch check-out console. (B) Mark-3 missile mating equipment.

MISSILE AND SPACE VEHICLE DEPARTMENT

GENERAL ELECTRIC

A Department of the Defense Electronics Division

Circle 14 on Inquiry Card

The catalog sheets shown here are descriptive of HOBART power supplies available to aviation and avionics industries!

Only at HOBART... can you get such a wide range of units to meet any type of ground power requirement.

Hobart machines are available to match the new requirements of today's aircraft, whether 400 cycle a.c., 28 or 112 volt d.c. In addition to the airlines and corporate users, airframe, powerplant, component part, helicopter and guided-missile manufacturers look to Hobart to meet their power supply needs.

It will pay to look into this! You can get your operations under way sooner and keep costs down when you use Hobart power supplies. 50 to 1500 amperes are available with wide continuously adjustable 26 to 31 volt range for either reciprocating or jet engine starting and testing. For the new jet aircraft and missile check-out and launching there are in the Hobart line, 400 cycle generators in capacities ranging from 3.75 to 125 KVA. This equipment is available in electric motor or engine driven designs and in the type of mounting you need. In other words, no matter what kind of equipment you're looking for, you can get it at one source—Hobart!

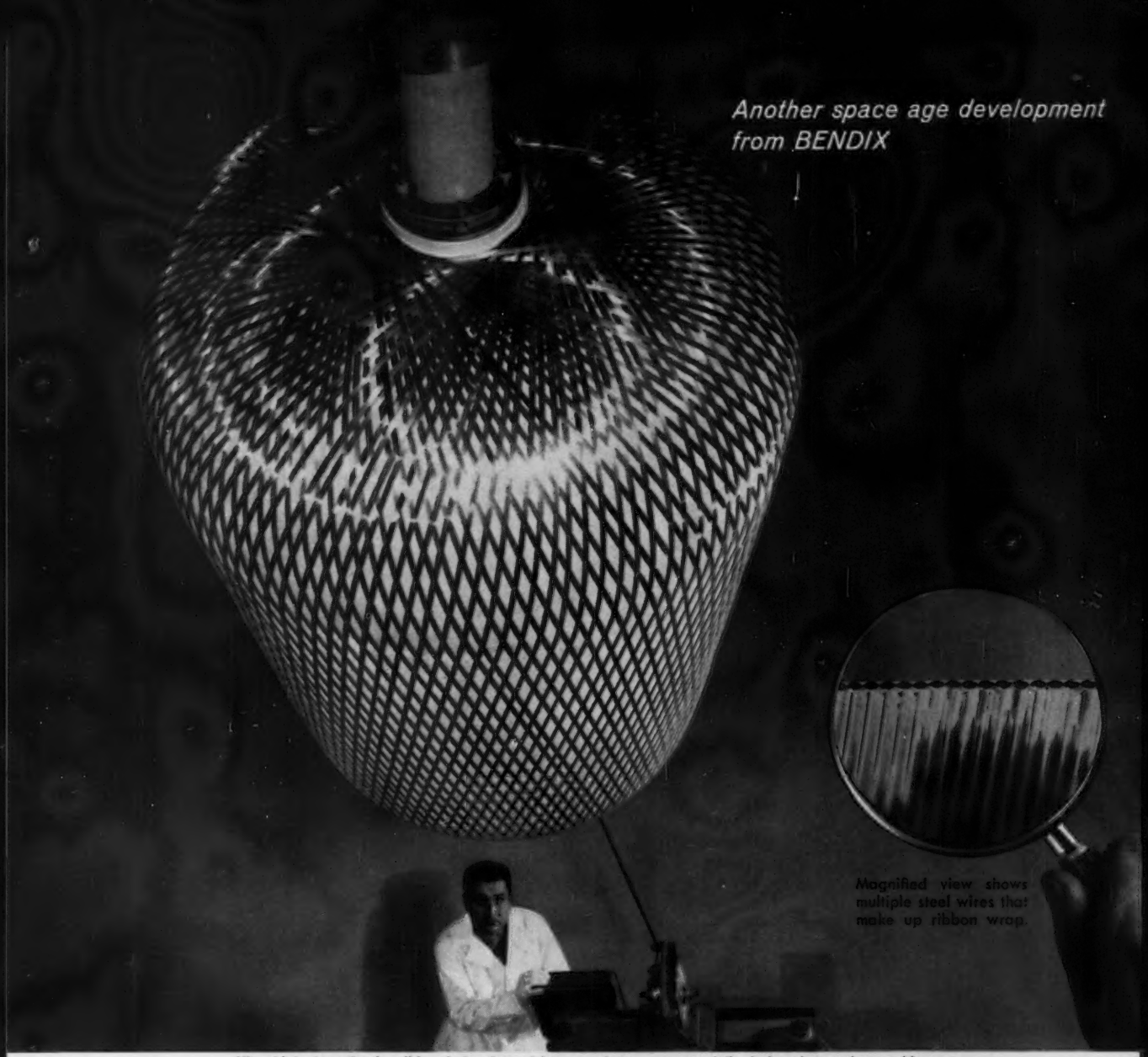
The company planning ahead in the fast-moving aviation field will do well to check into Hobart Power Supplies. Your inquiry will promptly bring complete literature and information on the equipment of interest to you. WRITE, PHONE, or WIRE today!

MOTOR GENERATOR CORPORATION · TROY, OHIO · Hobart · AUXILIARY POWER UNITS

MOTOR GENERATOR CORPORATION

Hobart Brothers Affiliate

Box AM-30, Troy, Ohio



Ultra high strength wire ribbon being formed into a rocket case on specially designed wrapping machine.

UNIQUE BENDIX WIRE *RibbonWrap* REDUCES WEIGHT, INCREASES RELIABILITY OF ROCKET CASES

Bendix has licked the problems of weight and reliability in flight weight pressure vessels. Secret of the Bendix-developed rocket cases: many tiny ultra high strength steel wires formed by adhesive bonding into a highly efficient ribbon. Weight and distribution of the binding adhesive is precisely controlled. Result—rocket cases with test strength as high as 531,000 psi, *equivalent to a hoop stress of 350,000 psi UTS in a homogenous case.* A specially designed Bendix machine generates the rocket case. The best wrap pattern for each case is mathematically determined and precisely controlled. Finished product is a rocket case tailor-made for configuration, strength and reliability.

For more complete information, write Rocket Equipment, Bendix Products Division, South Bend, Indiana.

The Bendix wire RibbonWrap gives you these important advantages:

Design Flexibility
Controlled Minimum Weight
Close Tolerances
High Temperature Strength
Shortest Prototype or Production Lead Time
Automated for Low Cost
Inherent Reliability

Bendix PRODUCTS DIVISION South Bend, IND.

Bendix AVIATION CORPORATION

Circle 16 on Inquiry Card

OSBORN®

BEFORE BRUSHING

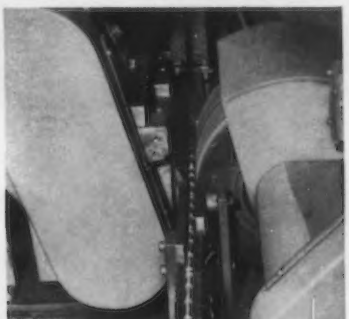
Magnified section of hardened steel hydraulic control valve. After machining, sharp edges and fine grinding burrs still remain—interfering with efficient long-life valve performance.

AFTER BRUSHING

Valve edges are precision blended . . . each radius microfinished to .002" tolerances. Burrs are thoroughly removed at the same time. Osborn Centerless Power Brushing does the job rapidly, economically . . assures increased, troublefree hydraulic valve life.

Microfinishing valve edges to a .002" radius

. . . at rates of 1200 parts-per-hour with OSBORN Power Brushing



CENTERLESS BRUSHING SETUP precision finishes hydraulic control valves at production rates of 1200 parts-per-hour. Finish blend on valve edges can be controlled to any desired microinch tolerance. Job is done on a centerless machine—with Osborn Matic® Centerless Brushes operating at 1750 rpm.

HYDRAULIC component manufacturers today—producing parts like this control valve—require ultra-high degrees of precision finishing. And Osborn Power Brushing helps meet the demands of modern high-pressure hydraulics with quality finishing, deburring and surface blending methods for hundreds of different types of parts.

In addition to the versatility and *precise quality control* afforded by Osborn Power Brushing methods—leading manufacturers also find that finishing operations are done more rapidly . . . at significantly lower cost.

An **O**sborn **B**rushing **A**nalysis—made in your plant at no cost or obligation—can pinpoint where you can speed production . . . improve quality . . . cut costs with modern Osborn Power Brushing. Write us for full details. *The Osborn Manufacturing Company, Dept., AM-9, Cleveland 14, O.*

Osborn Brushes®

METAL FINISHING MACHINES . . . AND FINISHING METHODS
POWER, PAINT AND MAINTENANCE BRUSHES • FOUNDRY PRODUCTION MACHINERY

Your Date Book

March 6-9

Gas Turbine Power and Hydraulics Conference
American Society of Mechanical Engineers
Rice Hotel, Houston, Texas

March 9-10

Symposium on Processing Materials for Re-entry Structures
Midwest Chapter, Society of Aircraft Material & Process Engineers
Miami Hotel, Dayton, Ohio

March 21-24

International Convention
Institute of Radio Engineers
Waldorf-Astoria and Coliseum, New York, N. Y.

March 23-25

Symposium on Optical Spectrometric Measurements of High Temperatures
University of Chicago, Jarrell-Ash Co., National Science Foundation
University of Chicago, Chicago

March 23-25

Ground Support Equipment Conference
American Rocket Society
Statler-Hilton Hotel, Detroit, Mich.

March 29-31

American Power Conference
Illinois Institute of Tech.
Sherman Hotel, Chicago

April 5-8

National Aeronautic Meeting
Society of Automotive Engineers
Commodore Hotel, N. Y., N. Y.

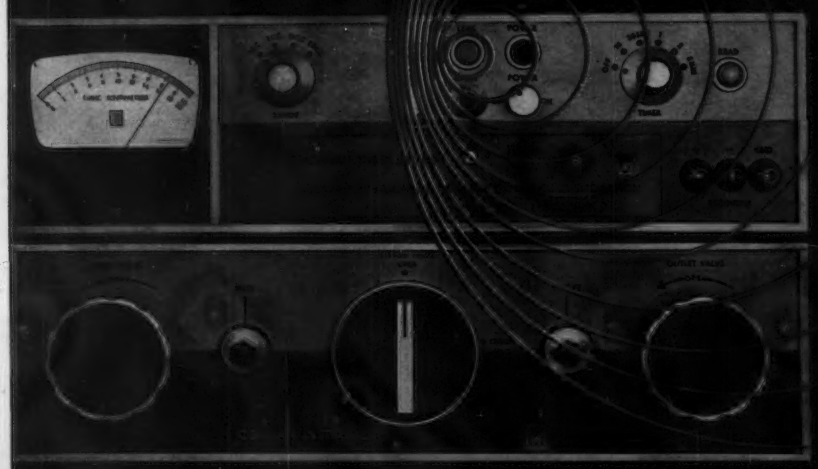
April 6-8

National Conference on Structural Design of Space Vehicles
American Rocket Society
Biltmore Hotel, Santa Barbara, Calif.

April 6-8

National Meeting on "Hyper-Environments-Space Frontier"
Institute of Environmental Sciences
Biltmore Hotel, Los Angeles, Calif.

some leaks don't make drops



the all-new CI LEAKMETER doesn't depend upon catching drops in the measurement of hydraulic or fuel leakage!

The CI LEAKMETER, *when installed in a line between a pressure source and the system or component under test, automatically detects and signals the existence of a leak. It automatically measures and indicates the amount of the leakage. A red light signals the presence of a leak –the amount of leakage is indicated on an electrical meter. The* LEAKMETER *incorporates a timer which can be set for test durations of 15 seconds to 5 minutes, providing a range for the instrument of 0.008cc to 80cc per minute. To measure other rates of leakage, or to test for sustained zero leakage, the timer may be overridden and the test conducted for any desired period.*

The LEAKMETER consists of an Hydraulic Assembly and an Electrical Assembly. These may be installed together, or at separate locations in the test area. Both are designed for rack mounting. Hydraulic connections are made by quick-disconnect fittings.

The LEAKMETER is compatible with all common hydraulic fluids and fuels. The item under test may be subjected to shock, vibration, or temperature, from which the LEAKMETER remains isolated. The instrument accommodates pressures to 5000 psi. Jacks are provided for recording or other readout.

For Complete Information–or to purchase a LEAKMETER *for Immediate Delivery, Write, Wire, or Phone:*

CONVAIR INSTRUMENTS / CONVAIR, A DIVISION OF GENERAL DYNAMICS CORPORATION

3595 Frontier Street, San Diego, California
ACademy 3-1614

ELECTROMECHANICAL AND MECHANICAL INSTRUMENTS; AC AND DC MEASURING DEVICES, TRANSDUCERS.

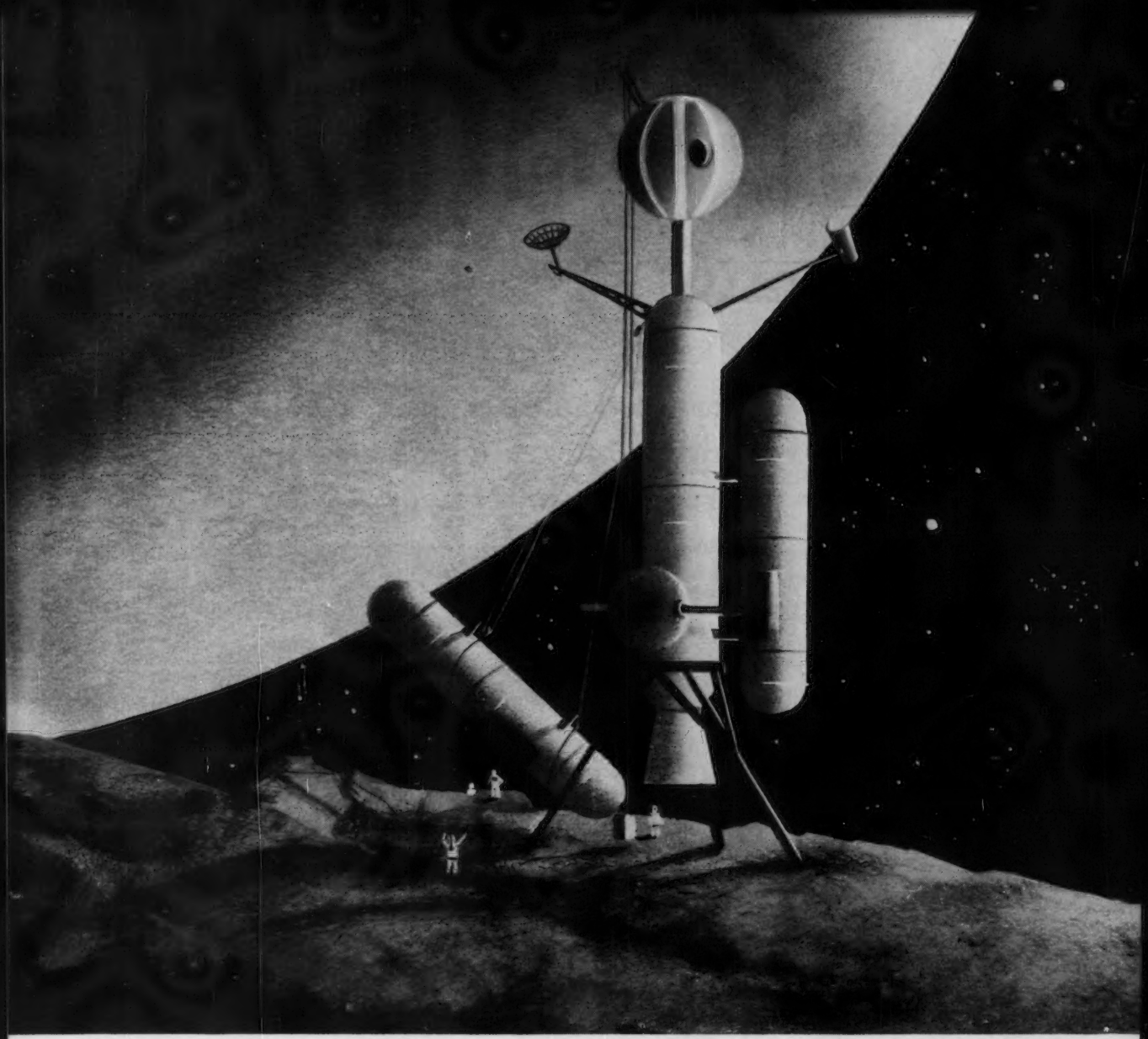
Here is Francis Alterman, Manager of General Mills Digital Computer Laboratory, checking one of our newest computers which he helped design. General Mills computers, both analog and digital, are being used in missile guidance, bombing and navigation systems, automatic surveying and in industrial control. In future space travel, computers will help control navigational systems of space vehicles and will process data gathered in outer space.

General Mills engineers work <u>today</u> .

General Mills has been producing computers for nearly 20 years. Exciting new concepts in high speed magnetic tape units, ultra-high precision analog to digital converters and optical keyboards are examples of continuous developments in our over-all computer program. We work to improve reliability, increase speed, cut cost.

Our research activities cover broad areas in physics, chemistry, mechanics, electronics and mathematics. Some of the studies representative of these activities are: ions in vacuum, deuterium sputtering, dust erosion, magnetic materials, stress measurements, surface friction and phenomena, trajectory data and infrared surveillance.

In our engineering department, current projects include: specialized inflatable vehicles and structures, airborne early warning systems, micro wave radar test equipment,



Mars seen from one of its moons . . . illustration from book written for General Mills by Willy Ley.

. to help you explore space tomorrow

antennas and pedestals, infrared and optics, inertial guidance and navigation, digital computers—and many other activities.

Our entire manufacturing department is geared to produce systems, sub-systems and assemblies to the most stringent military requirements. Our people have a wealth of experience in complex military projects.

Write for free booklets: (1) Complete research, engineering and manufacturing capabilities of the Mechanical Division (2) New booklet on General Mills computers.

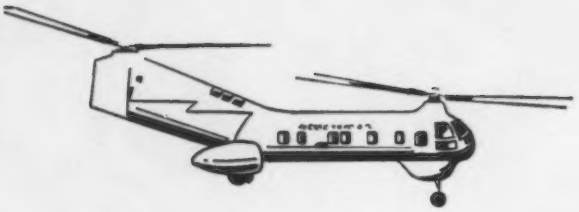
MECHANICAL DIVISION

1620 Central Avenue, Minneapolis 13, Minnesota

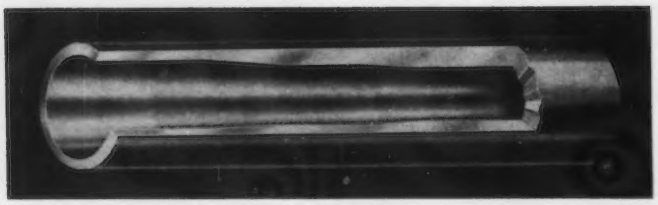
To wider worlds—through Intensive Research • Creative Engineering • Precision Manufacturing

General Mills

Circle 19 on Inquiry Card



more and more— "impossible" tubular parts are fewer and fewer



WITH ROCKRITE® SPECIAL-FORMED TUBING

How would you achieve a 22-foot D spar, for an all-metal rotary wing, with constant O.D. and with step tapered I.D. ranging from 4.190 to 3.720 inches? ROCKRITE-formed steel tube makes this "impossible" *possible* for a leading helicopter manufacturer—with improved strength characteristics and reduced costs. Details are available in Bulletin SP-1. It describes fully the unusual advantages of ROCKRITE TUBING for hard-to-make parts — not only from steel, but in zirconium, titanium and other exotic metals and alloys. Write today for your copy — no obligation.

STEP-TAPERED TUBING—*for structural members of wings and other highly stressed aircraft parts. Guaranteed defect-free quality.*

SPECIAL BORE TUBING — *bore shapes available: square, triangular and hexagonal, with very slight radius corners.*

RIBBED TUBING—*illustrates ability to work in rare metals and non-symmetrical configurations and eliminate machining and waste of expensive stock.*

SAE 52100 STEEL—*close tolerance and improved machinability for high-speed production of anti-friction bearing raceways.*

ROCKRITE® TUBING

TUBE REDUCING CORPORATION

A SUBSIDIARY OF AMERICAN METAL PRODUCTS COMPANY

MAILING ADDRESS: P.O. Box 959N, Passaic, New Jersey
520 Main Avenue, Wallington, New Jersey

D-514

UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS... WRITE AVCO/NASHVILLE TODAY.

Avco/Nashville: specialists in lightweight structures

Specifications for tomorrow's high-speed aircraft and missiles call for engineering and materials of unsurpassed *quality* . . . and quality is built into every product of Avco's Nashville Division.

Making structures of aluminum, titanium and stainless steel—including *Avcomb* stainless steel honeycomb structures—is a Nashville Division specialty. The *Convair 880* and *600* jet transports have major structural components built of Nashville aluminum honeycomb. The B-70 *Valkyrie* intercontinental bomber, designed for the Air Force by North American Aviation, will have large panels of stainless steel honeycomb in its fuselage.

Avco/Nashville's work in structures also includes airborne and ground radar antennae and large, heavy pedestals for ground radars. Nashville offers design, engineering and production facilities for a wide range of lightweight structures, including aluminum and stainless steel honeycomb.

At Nashville, each structures program is assigned its own task force of specialists backed up by the latest equipment for chemical milling, metal bonding and heat treating, including a brazing furnace large enough to accommodate stainless steel honeycomb panels up to 7 feet wide and 25 feet long.

For more information on Nashville's facilities and capabilities, write: General Marketing Manager, Structures Nashville Division, Avco Corporation Nashville, Tennessee

Avco/Nashville

Circle 21 on Inquiry Card

The Plan to Revamp World-Wide Communications

Signals bounced from "stationary" satellites could blanket Earth with TV, radio, telegraph; Total cost would be less than reworking present system to double capability

by George S. Shaw
Senior Vice Pres.
Radiation Inc.

Ninety five per cent of the space dollars spent in the next ten years is likely to be for vehicles which operate within 23,000 mi of Earth. For, this space radius offers the most utility for mankind. The opportunities for space-age miracles in world-wide communications and reconnaissance lie within this band.

If a satellite were put in equatorial orbit at 22,290 mi, it would make one orbit of Earth every 24 hr. Thus "synchronized", it would appear to hover over some point on the equator.

A network of "synchronized" satellites, tied-in with "close-in" polar satellites could be used for communications between any two points on Earth. (see diagram)

Need Arises — Present world communications are already overworked. Those conducted in the low frequencies between 2 and 25 megacycles, are interrupted by spheric disturbances, which radically reduce their utility. These links are augmented by very narrow band "scatter links" and by underwater cables.

Reflection of 25 to 200 mc radio waves by the ionosphere occurs only on a "sometimes" basis; and transmission on the high frequencies from 200 to 7000 mc is limited to line of sight (about 100 mi). Most of the radiant energy escapes ineffectively into outer space. Because of these factors, the amount of energy received by home TV sets may vary as much as 1000 to 1 when only 50 mi from a TV station.

EQUATORIAL LAUNCHING SITES for communications satellites are discussed by Radiation Inc.'s chief scientist, Dr. Conrad Hoeppner (left) and author Shaw. Greater payload can be launched from equator.

Radio waves at frequencies above 7000 mc are frequently dissipated by water vapor in the Earth's close-in atmosphere.

All these factors limit present world-wide long-wave communications to about 10 megacycles of continuously useful bandwidth.

Double World Communications —It would be of untold advantage if we could double the available frequencies by adding another 10 mc with a communications relay satellite. Just one "first generation" relay

communications satellite could effect this doubling over nearly half our globe. The vast band from 100 to 7000 mc could be used for satellite-to-Earth communications. Naturally, frequent review and reassignment of frequency allocations in this band would be required.

Further utility of the higher frequencies could be accomplished through the "spacial allocation" of these bands at different sectors of the orbit. This would enable simultaneous, multiple use of frequencies. Eventually, communications relay satellites paired with ground-directive, high-frequency antenna arrays could materially add bandwidth without the interference caused by present overcrowding. Similar application of directive arrays would permit outer space relaying from satellite to satellite on the frequencies above 7000 mc without interfering with Earth communication. Relay links from one side of Earth to the other would thus be established.

Aircraft could also maintain constant world-wide radio contact through satellite relays. Communications would be effective even over the polar areas where present long-wave communications are generally erratic. Polar orbit satellites can provide relay capability.

Moon Relay Station — The Moon has been used as a reflective relay station for signals from one part of Earth to the other. Its relay capability is available to only one side of Earth at a time, and then for only part of a day.

Tremendous earthbound transmitters are needed to beam enormous amounts of power at the Moon in order to receive a sufficient reflected signal back on Earth. Some improvement could be achieved by placing a giant antenna and active relay station on the Moon, permitting return signals to be aimed at Earth. However, the high power and the part-time performance of the Moon as a relay, indicate the 24 hr satellite system to be the more useful, and economical immediate choice.

Passive Satellites — A passive, artificial satellite may be employed as a space communications relay. However, most of the energy would escape into space with only a small amount reflected onto Earth. Such satellites are useful in experimentation. The collapsed, aluminized plastic bag launched from Wallops Island, Virginia, October 28, 1959, and inflated with water vapor at altitude, provided a great deal of vital information. Such a satellite will probably be placed in 24-hr orbit as a forerunner of a fully active electronic relay satellite.

In Project Echo, announced recently by NASA, U. S. hopes to place a passive aluminized balloon satellite in 120-min orbit 1000 mi above Earth. Launched by a Thor Delta rocket, it is designed to pass over countries located between 50 deg North and South latitude.

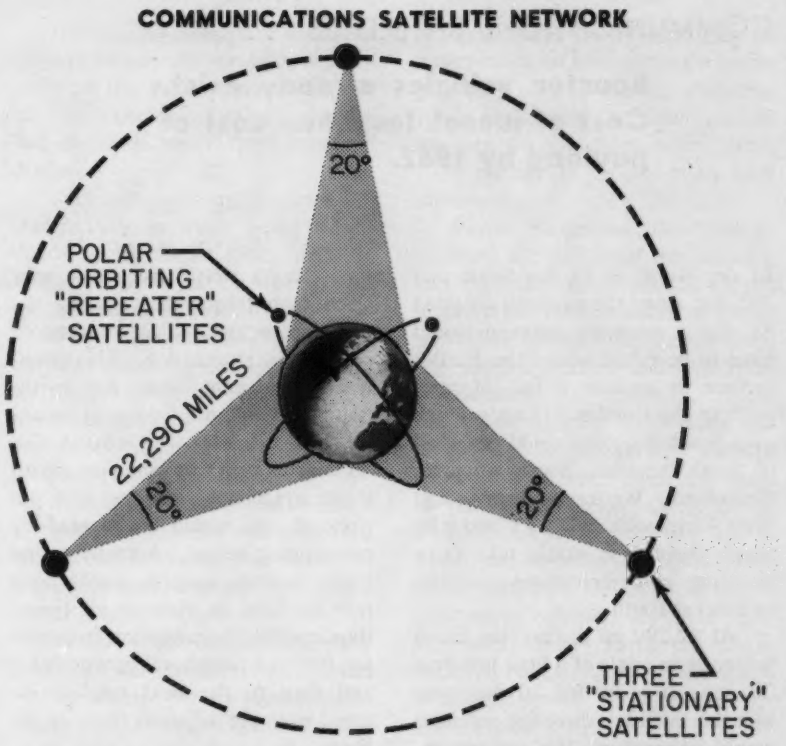
Powerful narrow band transmitters can bounce signals off passive satellites which can be picked up by narrow band receivers. But, this capability cannot practically be extended to continuous wide band TV transmission.

Studies so far have shown that there is no unknown "curtain" or severe attenuation of radio signals transmitted from outer space on frequencies between 200 and 7000 megacycles.

The conclusion is that an active electronic relay communications satellite in equatorial 24-hr orbit will be the most efficient for all kinds of space communications.

Equatorial Path—In order for a 24-hr satellite to remain "stationary" above a point on Earth, it must follow a path exactly over the Earth's equator. It must thus orbit in the same direction, plane and at the speed of the Earth's rotation on its polar axis.

From this point 22,290 mi in space, a directive antenna array (see cover) would radiate a cone of energy to one side of Earth, covering



WORLD-WIDE COMMUNICATIONS could be revolutionized by space satellites. Three "stationary" satellites, tied in with several polar repeaters, could blanket Earth. Overall project to achieve this is Notus; Task Courier, Task Steer, Task Decree and Task Tackle, are all parts.

Booster vehicles already exist. Cost of launch less than cost of payload by 1962.

81 deg North to 81 deg South and 162 deg along the equator. (Beyond 81 deg a receiving antenna would have to be raised above the Earth's surface to achieve a line of sight path to the satellite.) One satellite over South America could cover all of South America, North America, Greenland, Western Europe and West Africa with radio, TV and telegraph signals. It would take three hovering communications satellites to blanket Earth.

At 22,290 mi distant, the Earth subtends an angle of a little less than 20 deg. It is in this 20 deg cone that the satellite's directive antennas would concentrate the radiant energy so that only a little energy dissipates into space. At the periphery of the cone—the horizons—the signal strength would frequently vary since high frequencies grazing the atmosphere are subject to random changes in attenuation. This problem exists only when the earth-bound antenna must point at an angle less than 10 deg above the horizon to "see" the satellite. With three equatorial satellites, this peripheral area would be covered by overlapping beams. Actually, many Earth antenna systems would have two satellites in view at all times, thus enabling transmission from one satellite to a peripheral ground relay and then to the next satellite located over the adjacent third of the Earth.

More complex systems will require equipment which can transmit signals from one satellite directly to the next, simplifying true point-to-point communications around Earth.

Polar Regions—The North and South poles of Earth are slightly below the horizon of the equatorial satellite's conical transmission pattern. Communications in these regions could be achieved by increasing the power of the 24-hr satellite on certain narrow bandwidths. However, a constellation of polar orbiting satellites can better serve this limited region.

The polar satellite is likely to be a "repeater" or memory-type satellite capable of storing information for read-out when activated over a certain spot. Communications could be conducted on a scheduled basis, the exact satellite position and communications timetable mathematically computed.

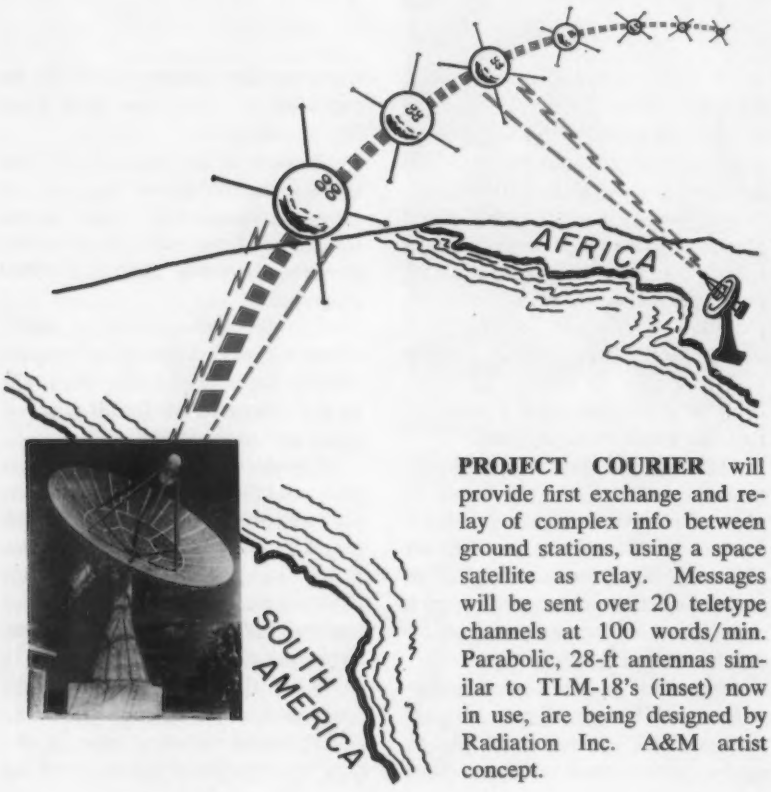
Early Active Satellites—Prototypes of a global communications network for the Armed Forces are being developed under Project Courier. Parabolic 28-foot antennas, being designed and fabricated by Radiation Inc. will simultaneously receive and transmit up to six million bits of information between satellite and ground stations within 4 min. They are similar in design to the TLM-18's now operating.

The Project Courier system is designed to provide 20 continuously available 100-word-a-minute teletype channels to "repeat" messages transmitted between ground stations.

As the satellite passes over station "A," it is "acquired" and a micro-wave communications link established. Station "A" then commands a "readout" of information on storage tape "A" in the satellite. This information is recorded and processed by the ground complex.

A second command starts recording information from Station "A" onto Station "B" or "C"'s tape, which is then "read out" by station "B" or "C" as the satellite passes overhead.

The Project Courier communications-tracking network will provide the first exchange and relay of complex information among world-wide ground stations using a satellite as



PROJECT COURIER will provide first exchange and relay of complex info between ground stations, using a space satellite as relay. Messages will be sent over 20 teletype channels at 100 words/min. Parabolic, 28-ft antennas similar to TLM-18's (inset) now in use, are being designed by Radiation Inc. A&M artist concept.

a "space station." The project is similar in basic function to that of Project Score which used the Radiquad antennas to pick up President Eisenhower's pretaped voice.

Launching Sites—Due to the high thrust needed to put the communications satellite into an equatorial orbit from the northern hemisphere, a launching site along the equator would be better. A greater payload per pound of thrust could be put in orbit. An effective and efficient 24-hr satellite will probably be launched from the equator regardless of the nation that launches it—US or USSR.

A vehicle launched from the northern hemisphere and turned to the equatorial orbit would require as much as 90 per cent of its payload solely to provide this turn into proper orbit. Thus, it would be more practical and economical to build a properly instrumented launching site on the equator.

The polar oriented satellites, however, could be launched from present sites and achieve satisfactory orbital paths.

Satellite Mechanisms — Contained in the satellite itself will be a complex assortment of component systems. Primary of these will be the station-keeping and stabilization system necessary to place the instrument laden carrier precisely in orbit and pointed at Earth. This system will consist of a speed adjustment control, and jet mechanisms for accomplishing a near circular orbit with a velocity of approximately 10,000 ft per sec. Extremely accurate radio distance measurement equipment on Earth must be utilized to determine if the satellite is leading or lagging the prescribed path. Electronic computers on Earth will calculate the direction and magnitude of corrections required, and signals will be relayed to the satellite, activating small, delicate jets oriented forward, reverse, up and down. Corrections will occur frequently during the first few hours or days until a precise 24-hr orbit has been achieved.

For broadcasting from the satellite, is is essential that it point toward Earth within a half degree.

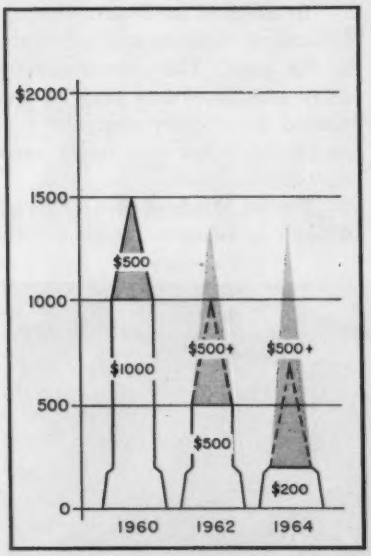
Command guidance of the satellite will be essentially similar in principle to the pulse control used in the radio control of model aircraft, but of much more "sophisticated" design.

Such advanced and complex RF transmitters as those being developed by Radiation Inc. for the ICBM program can be modified for use in satellite systems.

Other Equipment—The principal area requiring development will be long-range accurate radio distance measuring or triangulation equipment, required for the precise location of the satellite.

In addition to the station-keeping gear, the satellite will contain a variety of receiving and transmitting equipment, antennas and a solar power generator.

Receiving antennas on the early satellites will probably be of the narrow beam type to permit energizing of the relay satellite from a small area on the North American continent. Modulated by sensitive receivers, transmitters will then relay the signal through either a wide beam antenna for broadcasting or a narrow beam transmitting antenna providing signals to a restricted area. Equipment for inter-satellite relaying on the frequencies above 7000 mc would be added to later satellites.



COST OF LAUNCHING payload will be reduced to $200/lb by 1964. This would be considerably less than cost of fabricating the payload. Payload costs will be driven up by micro-module electronics as better boosters cut launching costs.

Power Requirements—Directly affecting the weight of the payload, and thus the thrust needed to put it into orbit, is the amount of power needed to operate the station-keeping control circuits and the relay transmitters.

Conservatively, 1000 watts will be required to provide 200 watts of transmitted power. Since 20 watts of power per megacycle of bandwidth, beamed in a 20 deg arc to Earth, can be satisfactorily received by a 10db directive antenna and a parametric receiver, the 200 radiated watts could provide 10 megacycles of bandwidth. This is enough to double present hemisphere communications.

The primary power is best provided in the vehicle by solar cells. A solar cell power system can generate from 1 to 2 watts per pound of solar cell structure. Thus, an orbital vehicle weighing about 2000 to 3000 lb can provide 10 mc of new bandwidth for hemisphere use.

Launch Vehicle — A multiple stage vehicle capable of launching a 2000-lb payload from the equator can now be assembled. An ICBM booster with two or possibly three additional stages could accomplish the task.

However, 10,000-lb payload capabilities will undoubtedly exist by the time operational, reliable, thoroughly tested, 24 hr satellite payloads can be designed. The planned Saturn vehicle could conceivably launch an electronic relay station of 50,000 lb to provide twenty times the present world-wide communications capability.

Antenna Requirements — The communications satellite antennas needed for guidance transmission and reception require only system integration design. Ground based antennas now in use at the Atlantic and Pacific Missile Ranges could be used, with modifications, for transmission of information to the satel-

Project Courier prototype of more sophisticated systems. Will relay teletype message on 20 channels.

lite. The 250-ft Jodrel Bank installation in England and the 600-ft Naval installation under construction might also be utilized, although their large size is not a necessity.

For home reception of the relayed radio and TV signals, an antenna similar to a fringe area TV antenna would be sufficient to receive a broadcast originating on another continent. Such an antenna has the suitable power gain and can be inexpensively directed toward the satellite.

Mobile equipment for ground and airborne vehicles would require directional antennas with relatively simple servo-type pointing mechanisms. Probably transmissions would be on higher frequencies than used for fixed base or home installations, permitting a reduction in the size of the mobile receiving antenna.

What About Costs?—The cost per communication in this new environment would probably be 1/1000th to 1/100,000th of that incurred by an intercontinental expansion of our ground communications network.

It is reported launching vehicles now under construction can boost payloads into space for $500/lb with about 500 lb of launch vehicle required to put each pound into orbit. It is reported that payload launching costs may be reduced to $200/lb by 1964. Space communications equipment can be launched for less than its own cost of construction at either price. The development of a suitable operational communications relay satellite system would cost between $50 and $200 million exclusive of launching site. However, duplication of the satellite relays would cost less than $10 million.

After this initial research, development and engineering is completed, the cost per kilocycle mile minute of communications via the relay satellite systems should be less than one thousandth present communications costs.

In terms of the future, then, the investment would be small compared to the gain. The communications relay satellite system may be considered as a costly generator with an extremely low cost long-distance distribution system.

For the Minds of Men—It is not difficult to imagine the impact the first space communications satellite will have on the minds of the people of the world. The impact would be reiterated each day by programs beamed at the people of a country in their own language and received over their home radio and TV sets.

The small number of TV receivers throughout the rest of the world limits the immediate effectiveness of TV. The liability of providing receivers would fall upon the nation doing the transmission. Russia as yet is not as equipped to do this as the United States and would thus probably attempt to influence principally by means of world-wide radio.

We are in a race for the minds of men. The Soviet Union is the largest single power on Earth with nationalized rails, airlines, power and communications. Russia is advanced enough to soon assume the task of establishing a satellite relay communications system for her world-wide propaganda use. With 10 megacycles of bandwidth or the equivalent of two TV channels, in 24-hr orbit, the Soviet Union can equal the present world-wide communications circuits. This, followed by more satellite systems of 100 megacycles bandwidth each, could saturate the world with 100 times the present communications media —all communist oriented. American industry today has the knowledge and capability for producing a communications relay satellite. The launching vehicle, antenna systems, solar power source, and electronic equipment are either in existence or could be designed from present state-of-the-art. A missing link is a developed equatorially located launching site. However, this could be obtained and construction completed during the satellite development period.

◆

TRACKING ANTENNAS similar to this large TLM shown being pieced together, could be used for sending messages via satellite. Courier will use 28-ft parabolic antenna.

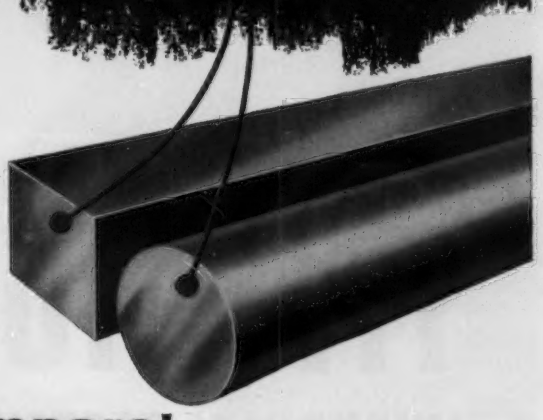
A REPRINT
of this article can be obtained by writing on company letterhead to The Editor, AIRCRAFT & MISSILES Chestnut & 56th Sts., Phila, 39, Pa.

For critical design applications . . .

VAC-ARC* Steels

Latrobe's know-how guarantees reliability

Production know-how gained in making highest quality tool and die steels gives Latrobe an advantage in producing VAC-ARC (consumable vacuum melted) steels to meet critical design requirements. VAC-ARC Steels possess unusual cleanliness, improved ingot structure, and superior mechanical properties.



VAC-ARC Grades Available . . .

APPLICATION	TYPE	GRADE NAME
High Temperature	A-286	Pandex
Bearings	M-50	MV-1
	52100	Regent
Aircraft & Missile	H-11	Dynaflex

Compare!

TYPICAL TRANSVERSE TENSILE PROPERTIES
(8" square billet of Dynaflex)

Property	Mid-Radius		Center	
	Air Melt	Vac-Arc	Air Melt	Vac-Arc
Tensile Strength (psi)	285,000	287,000	285,000	285,000
Yield Strength .2% (psi)	250,000	252,500	245,000	250,000
Elongation %	4	8	2.5	8
Reduction of Area %	10	25	3	24

Call your Latrobe representative . . . or write for literature.

LATROBE Metalmasters

LATROBE STEEL COMPANY
LATROBE, PENNSYLVANIA

BRANCH OFFICES and WAREHOUSES:
BOSTON • BUFFALO • CHICAGO • CLEVELAND • DAYTON • DETROIT
HARTFORD • LOS ANGELES • MIAMI • MILWAUKEE • NEW YORK
PHILADELPHIA • PITTSBURGH • SAN LEANDRO • TOLEDO

*Latrobe's Trade Name for Vacuum Consumable Electrode Melting

TITANIUM

HUCKBOLT* FASTENERS

NEARLY 50% INSTALLED WEIGHT SAVING POSSIBLE WITHOUT STRENGTH PENALTY

Titanium Huckbolt Fasteners meet today's advanced design requirements with these desirable features:

- **High strength at elevated temperatures.**
- **Low weight to strength ratio.**
- **Positive mechanical lock.**
- **High shear and tensile strength.**
- **Excellent pull-together.**
- **Uniform installation with high tensile preload.**
- **Self-sealing design.**
- **Maximum structural integrity.**
- **Easy removal without work damage.**

1 and 2
AL-Tension-type
Huckbolt Fasteners
3 and 4
SAL-Shear-type
Huckbolt Fasteners

*T.M. of Huck Manufacturing Company

For complete information—write or call licensees:

VOI-SHAN
MANUFACTURING COMPANY
A division of PHEOLL MANUFACTURING COMPANY
8463 Higuera Street • Culver City, Calif.
(Licensee)

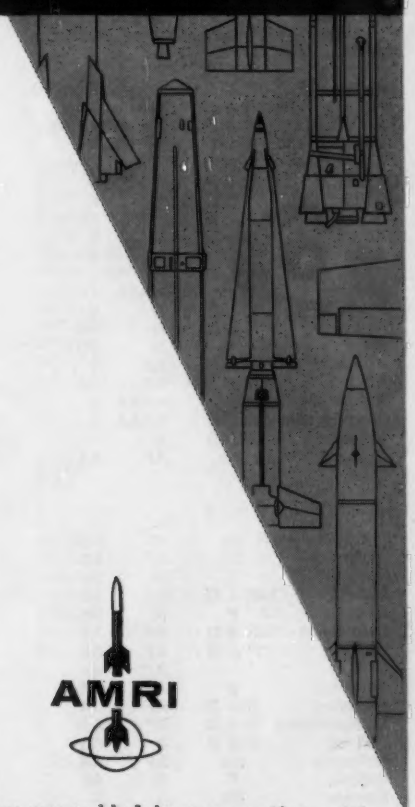
HUCK
MANUFACTURING COMPANY
2480 Bellevue Ave., Detroit 7, Mich.

AIRCRAFT / MISSILE DIVISION
STANDARD PRESSED STEEL COMPANY
SPS
Jenkintown, Pennsylvania
(Licensee)

Licensed under Huck patents No. 2,527,307 2,531,048, 2,531,049 and 2,754,703

AIRCRAFT & MISSILES

1960 MISSILE HANDBOOK



The second Annual Missile Handbook has been compiled as an engineering-sales service to the thousands of companies seeking new business in the giant $14.6 billion aerospace industry.

Participation in the industry requires some intelligence of what has been done in the past, what is being done now, and what is planned for the future. To this end, The Handbook contains a list of all projects undertaken since World War II, a directory of missiles now in production or receiving major funding, and a definition of projects which show strategy and intent for the future. The latter should help engineering and sales forces alike in guiding the future of their companies. The mass of information contained here will aid small companies in placing their specialized skills; and will aid large companies in locating the talented specialists that have proved so essential in designing and producing aerospace vehicles.

The ideas and markets which make up the aerospace industries have no geographic confines. One thing that has been learned in the few short years of its existence is that liaison and cooperation between persons, companies, industries, and even nations, are essential to meet the challenging pace. A fantastic amount of time is lost each year in planning trips and seeking out companies to sell to and buy from through the existing dispersed information. This handbook will serve as the industries' only consolidated guide.

AMRI

Information assembled in cooperation with Kendall K. Hoyt, Director

ASSOCIATION OF MISSILE & ROCKET INDUSTRIES

United States Missile Projects

This is an alphabetical listing of all known missile and space projects undertaken by U. S. since World War II.

Name	Status	Service	Mission
A			
A-4	O	AF	Drone
Able	R & D	A	SS
Able I	R & D	—	X
Adam	dis	A	SS
Aerobee	O/dis	AF,N	X
Aerobee-Hawk	R & D	A	SA
Aerobee 150	O/dis	AF	X
Aeropak	R & D	A	—
Aerosound	R & D	AF	X
Agile	R & D	N	AA
ALBM	R & D	AF	AA,AS
Alpha Draco	R & D	AF	X
AN/USD-2	R & D	A	Drone
Arcas	R & D	N	X
Arcon	R & D	N	X
Argo D-4	R & D	A,N	X
Argo D-8	R & D	A	X
Argo E-5	O	—	X
ARM	R & D	AF	—
ASP	O/dis	NASA	X
Aspan	R & D	N	X
Asroc	R & D	N	SU
Astor	P	N	SU
Astrobee	R & D	AF	X
Atlas	P	AF	SS
Atlas-Able	R & D	NASA	X
Atlas-Hustler	R & D	NASA	X
Automet	R & D	A	—
Azon	dis	AF	AS
B			
Bat	dis	N	AS
BDM	dis	AF	SA
Betty	O	N	Su
Big Stick	R & D	AF	SS
Boar	P	N	AS
Bold Orion	R & D	AF	AS
Bolo	R & D	AF	SS
Bolt	—	A	—
Bomarc I	P	AF	SA
Bomarc II	R & D	AF	SA
Bombardment	R & D	AF	AA
Bulldog	R & D	N	AS
Bullgoose	dis	AF	AA,AS
Bullpup	P	N	AS
Bumper	dis	A	X
C			
Cajun	O/dis	A	X
Caribe	R & D	N	UU,SU
Cat	R & D	—	X
Centaur	R & D	NASA	Sat
Cherokee	R & D	AF	X
Chopper John	R & D	A	SS
Claymore	R & D	A	—
Cobra	R & D	A	SS
Corporal	O/dis	A	SS
Corvus	R & D	N	AS
Courier	R & D	A	Sat
Cree	R & D	AF	X
Crossbow	dis	AF	AS
Crow	R & D	N	AA
D			
Dan	dis	AF	X
Dart	dis	A	SS
Dash	R & D	—	AS
Dat	R & D	N	UU, Drone
Davy Crockett	R & D	A	—
Deacon	P	A	X
Decree	R & D	A	Sat
Delta	P	—	X
Dervish	R & D	A	SS
Diamondback	R & D	N	AA
Discoverer	R & D	AF	Sat
Dove	dis	N	AS,AU
Duck	dis	AF	AA
Dyna-Soar	R & D	AF	X
E			
Eagle	R & D	N	AA,AS
Envoy	R & D	—	SA,X
EX-8	R & D	N	SU
Exos	R & D	N	X
F			
Falcon GAR-I	O/dis	AF	AA
Falcon GAR-II	dis	AF	AA
Falcon GAR-III	P	AF	AA
Falcon GAR-IV	P	AF	AA
Falcon GAR-9	R & D	AF	AA
Falcon GAR-11	R & D	AF	AA
Far Side	dis	AF	X
Father John	dis	A	X
Fire	R & D	N	SS,US
Firebee	O	A	X
Firefly	R & D	—	—
Firepower	R & D	A	SS
G			
Gander	R & D	AF	Drone
Gapa	dis	N	SA
Genie	O	AF	AA,AS
Gimlet	dis	AF	AS
Gnat	R & D	N	SA
Goose	dis	AF	AS,SS
Gorgon	dis	N	Drone
Grebe	R & D	N	AS
H			
Hare	R & D	AF	AA,AS
Harpy	R & D	A	SA
Hasp	R & D	N	X
Hawk	O	A	SA
Hermes	dis	A	X
Hilo	R & D	A,AF	Drone
Holy Moses	dis	N	AS
Honest John	O	A	SS
Hopi	P	N	AS
Hot Point	R & D	N	AS
Hound Dog	R & D	AF	AS
HTV	dis	AF	X
HVAR	O/dis	N	AS
I			
Iris	P	N	X
J			
Jaguar	R & D	AF	AS
Jason	R & D	—	X
Juno I	O/dis	A	X
Juno II	O/dis	A	X
Juno IV	R & D	A	X
Juno V (Saturn)	R & D	NASA	X
Jupiter	O	A	SS
Jupiter C	O	A	X
K			
Katie	R & D	N	SS,SU
KD2B-1	R & D	AF,N	Drone
KD2R-5	O/dis	AF,N	Drone
Kingfisher	R & D	A	SA, Drone
L			
Lacrosse	O	A	SS
Lark	dis	N	AA
Lazy Dog	R & D	AF	AS
Little Jim	R & D	A	—
Little Joe	R & D	S	X
Little John	P	A	SS
Lobber	R & D	A	SS
Loki	O	A	SA
Loki-Wasp	O	A,N	X
Loon	dis	N	X
Low Blow	R & D	N	SA
Lulu	P	N	AU,SU

Name	Status	Service	Mission
M			
Mace-A	P	AF	SS
Mace-B	P	AF	SS
Mark 32	O	N	SU
Mark 37	O	N	SU
Mark 39	P	N	AU
Mark 43	O	N	AU,SU
Mark 44	R & D	N	SU,UU
Mark 46	R & D	N	UU,US
Matador	O/dis	AF	SS
Mauler	R & D	A	SA
MCM	R & D	AF	SA
Mercury	R & D	NASA	Sat
Midas	R & D	AF	Sat
Midgetman	R & D	AF	SS
Methuselah	R & D	AF	X
Mighty Mouse	O/dis	N,AS	AA
Minuteman	R & D	AF	SS
Missile A	R & D	A	SS
Mrs. V	dis	ARPA	Sat
N			
NASA 6-stage	R & D	NASA	X
Nasty	dis	AF	AA
Navaho	dis	AF	SS
New Horizons	R & D	—	X
Nike-Ajax	O/dis	A	SS
Nike-Asp	O/dis	A	X
Nike-Cajun	O/dis	A	X
Nike-Hercules	O	A	SA
Nike-Zeus	R & D	A	SA
Nomad	R & D	AF	SA
Notus	R & D	ARPA	Sat
Nova	R & D	NASA	X
O			
OQ-19D	O	AF	Drone
Oriole	dis	AF,N	AA
Orion	R & D	ARPA	X
Owl	O	AF	X
P			
PD-121	R & D	A	Drone
Penny	R & D	—	Drone
Pershing	R & D	A	SS
Petrel	O/dis	N	AS
Plato	dis	A	SA
Pluto	R & D	AF	—
Pogo	R & D	N	Drone
Polaris	R & D	N	US,SS
Pontus	R & D	ARPA	—
Principia	R & D	ARPA	—
Private A	dis	A	X
Private F	dis	A	SS
Purr-Kee	R & D	N	X
Q			
Q-2C	P	AF	Drone
Q-4 (A)	O	AF	Drone
Q-5	R & D	AF	Drone
QB-17	R & D	AF	Drone
QF-80	R & D	AF	Drone
QF-104	R & D	AF	Drone
Quail GAM-72	O	AF	AS,SS
QX-10	R & D	AF	Drone
R			
Rambler	dis	—	X
Rascal	dis	AF	AS
RAT	dis	N	SU,AU
Raven	R & D	N	AS
Razon	dis	AF	AS
Recon	R & D	A	SS
Redeye	R & D	A	SA
Redstone	O	A	SS
Regulus I	O/dis	N	SS
Regulus II	dis	N	SS
Robin	R & D	AF	X
Rockaire	dis	N	X
Rockoon	O	N	X
Rover	R	AF	X
RP-7D	R & D	A	Drone
RP-71	O	A	Drone
RP-76	O	A	Drone
RP-77	O	A	Drone
Ryan M-109	—	—	—
S			
Samos (Sentry)	R & D	AF	X
Sarah	R & D	N	AS,AA
Saturn	R & D	NASA	X
Scout	R & D	NASA	X
SD-1	O	A	Drone
SD-2	P	A	Drone
SD-2X	R & D	A	Drone
SD-3	P	A	Drone
SD-4	R & D	A	Drone
SD-5	R & D	A	Drone
Sergeant	P	A	SS
Shepherd	R & D	ARPA	Sat
Shillelagh	R & D	A	SS
Shrike	dis	AF	X
Sidewinder	O	N,AF	AA
Skokie	R & D	AF	X
Skybolt	R & D	AF	AS
Skydart I	P	AF	Drone
Skydart II	R &	AF	Drone
Slam	R & D	AF	SS
Slim	R & D	N	UAU
Snark	O/dis	AF	SS
Snooper	R & D	A	Drone
Solar	R & D	AF	X
Spaerobee	R & D	AF	X
Sparrow I	O/dis	N	AA
Sparrow II	dis	N	AA
Sparrow III	O	N	AA
Sprayer	R & D	—	—
SPU	R & D	N	UU
SR-199	R & D	AF	SS
SS-10	O	A	SS
SS-11	O	A	SS,AS
Start	R & D	AF,N	X
Strongarm	R & D	—	X
Subroc	R & D	N	US,SS
Super Talos	R & D	N	SA
Suzano	dis	ARPA	Sat
Swallow	P	A	Drone
T			
T-33	R & D	—	X
Talos	O	N,A	SA
Tart	P	AF,N	—
Tartar	P	N	SA
TCBM	R & D	AF	SS
Teal	O	N	Drone
Terrapin	dis	N	X
Terrier I	O	N	SA
Terrior II	R & D	N	SA
Thor	O	AF	SS
Thoric	R & D	AF	SS
Thor Able	O/dis	AF	X
Thor-Agena	O	AF	X
Thor-Delta	R & D	NASA	X
Thor-Hustler	dis	NASA	X
Tiros	R & D	NASA	X
Titan	R & D	AF	SS
Tribe	R & D	ARPA	—
Triton	dis	N	SS
Transit	R & D	ARPA	Sat
V			
Vanguard	O/dis	N	Sat
Vega	dis	NASA	Sat
Vela	R & D	ARPA	—
Viking	dis	N	X
W			
WAC Corporal	dis	A	X
Wagmight	R & D	A	—
Wagtail	R & D	AF	AS
Wasp	R & D	N	X
Weapon Able	O	N	SU
White Lance	R & D	AF	AS
Willow	R & D	A	—
Wizard	R & D	AF	SA
WS-121B	R & D	AF	AS
Woofus	dis	N	X
WS-126A	R & D	AF	AA
WS-132A	R & D	AF	AA,SA
XYZ			
X-7A3	R & D	AF	X
X-10	dis	AF	X
X-15	P	AF,N	X
X-17	R & D	AF	X
XKDB-1	P	N	Drone
XKD4R-1	O	N	Drone
XM-15	—	A	—
XQ-4A	R & D	AF	Drone
XSM-64	O	AF	X
YQ-1B	O	AF	Drone
Zuni	O	N	AA,AS

LEGEND

Status

R & D—research and development
P—production
O—operational
O/dis—operational, production discontinued
dis—discontinued

Service

A—Army
AF—Air Force
N—Navy
NASA
ARPA

Mission

AA—air-to-air
AS—air-to-surface
AU—air-to-underwater
Drone—drone
SA—surface-to-air
Sat—space-probe
SS—surface-to-surface
UU—underwater-to-underwater
X—experimental

Missile Directory and Data

All projects listed offer contract potential. Those projects not in production or advanced development have been omitted.

This information has been assembled from many sources. The editors express thanks to all who assisted. Every attempt has been made to verify missile configurations and data.

AEROBEE (series)

Service: NASA (IGY)
Type: Sounding rocket
Status: In use

Physical Data

Height: 38 ft (-200)
Diameter: 31 in. (-200)
Weight: 9350 lb less payload
Remarks: Whole series of Aerobees exists, and continue to evolve. Used very widely as a sounding rocket for gathering research data. The -200 can put 1000-lb payload at 200 mi.

Contractors

Airframe: Aerojet-General
Guidance: None or command
Propulsion: Aerojet-General
Remarks: Powered portion of flight has 22 sec duration on = 200. Sea-level thrust is 71,-000 lb. Engine has been proven by Army Ordnance.

ASPAN

Service: NASA (IGY)
Type: Sounding Rocket
Status: Widely used

Physical Data

Height: 106 in. (no booster)
Diameter: 6.5 in.; 20 in. fins
Weight:
Remarks: Also called Nike-Asp. One of the most successful and versatile research rockets. About 25 firings this year.

Contractors

Airframe: Cooper Dev. Corp.
Guidance: None
Propulsion: Allegheny Ballistics Lab, Thiokol
Remarks: Contains various instrument packages ranging up to 75 lb. Uses Type M nike booster. Was used during Project Eclipse.

ATLAS

Service: Air Force
Type: ICBM (5000 mi)
Status: Production

Physical Data

Height: 82.5 ft
Diameter: 10 ft at tanks, 16 ft at base
Weight: 120 tons
Remarks: Now being equipped with ablation nose cones. GE-MSVD has $100 million.

Contractors

Airframe: Convair, Thompson Ramo-Wooldridge
Guidance: GE/Burroughs, Bosch Arma
Propulsion: Rocketdyne
Warhead: Sandia Corp., GE-MSVD
Remarks: Two boosters, 1 sustainer, 2 verniers, all liquid.

ATLAS-ABLE

Service: NASA
Type: Venus probe launcher
Status: Development

Design Data

Three stage: 1st modified Atlas 2nd, modified Vanguard 2nd stage 3rd, improved Vanguard 3rd stage

Contractors

Airframe: Convair, Martin
Guidance: GE/Burroughs, Bosch Arma
Propulsion: Rocketdyne, Aerojet Alleghany Ballistics
Warhead: STL (instrumentation)

ATLAS-HUSTLER

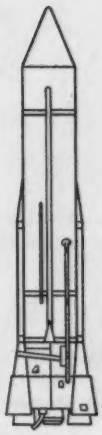
Service: NASA
Type: Satellite
Status: Development

Design Data

Object is to orbit 3000 lb payload. Two stage: 1st modified Atlas. 2nd Bell Hustler. AGENA will be used as an upper stage in future.

Contractors

Airframe: Convair
Guidance: GE, Burroughs
Propulsion: Rocketdyne, Bell (Hustler or Agena)
Remarks: Allied to Projects MIDAS and TRIBE



CENTAUR

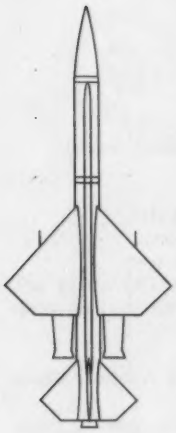
Service: NASA
Type: Satellite launcher
Status: Development

Physical Data

Height: 110 ft (est)
Diameter: 96 in.
Weight:
Remarks: Orbit 10,000 lb close in; 2,500 lb in stationary orbit; 730 lb in Moon orbit

Contractors

Airframe: Convair
Guidance: Librascope, Minn-Honeywell
Propulsion: Rocketdyne 1st, P&W 2nd
Warhead:
Remarks: Would use XLR-115 liquid hydrogen second stage



BOMARC B

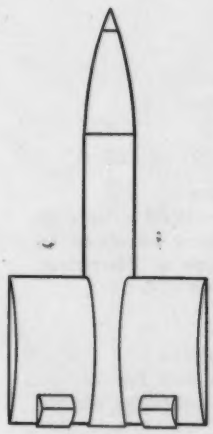
Service: Air Force, RCAF
Type: Surface-to-air
Status: Production

Physical Data

Height: 47 ft
Diameter: 18 ft span
Weight: 15,000 lb
Remarks: Range 450 mi, Mach 5 above 60,000 ft.

Contractors

Airframe: Boeing
Guidance: Remington Rand, Westinghouse
Propulsion: Thiokol (Solid booster) Marquardt (ramjets)
Warhead: Nuclear, Sandia Corp.
Remarks: Burns & Roe, Farnsworth Elect, AMF, ACF, Food Machinery & Chemical, are major in ground support.



COBRA

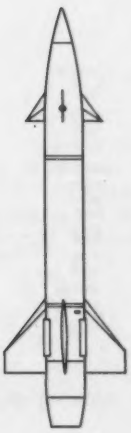
Service: Marines
Type: Anti-tank
Status: Production

Physical Data

Height: 30.7 in. long
Diameter: 6 in. (est)
Weight: 20 lb
Remarks: Wire guided. German developed by Boelkow-Entwicklungen, Munich. Carries 5.5-lb shaped charge. Also called Kobra.

Contractors

Airframe: Daystrom Inc.
Guidance: Wire
Propulsion: Solid
Warhead: Shaped charge.



BULLPUP

Service: Navy, Air Force
Type: Air-to-surface
Status: Production

Physical Data

Height: 11 ft-2 in.
Diameter: 1 ft; 3 ft-7 in. span
Weight: 575 lb
Remarks: Liquid prepack engines replacing solids. Range over 3 mi at M2.0

Contractors

Airframe: Martin
Guidance: Martin, Republic (Radio Link)
Propulsion: Reaction Motors
Warhead: Vary, include nuclear
Remarks: New Navy version called Super Bullpup. Air Force originally called missile White Lance, now GAM-83

CORPORAL

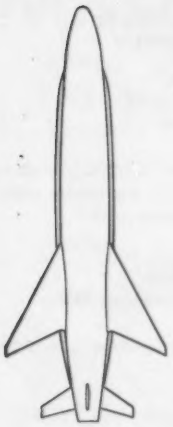
Service: Army
Type: Surface-to-surface
Status: Production

Physical Data

Height: 45 ft
Diameter: 30 in.; span 84 in.
Weight: 11,000 lb
Remarks: Preset or command guidance. Range 75 mi. Ballistic

Contractors

Airframe: Firestone, Gilfillan Bros.
Guidance: Gilfillan Bros. (command)
Propulsion: Ryan Aeronautical
Warhead: Sandia Corp. (nuclear)
Remarks: Limited production future. R. G. Fourneau has ground support.



CORVUS

Service: Navy
Type: Air-to-surface
Status: Production

Physical Data

Height:
Diameter:
Weight:
Remarks: Standoff missile intended to silence enemy radar nets

Contractors

Airframe: Temco
Guidance: W. L. Maxsom, Texas Inst.
Propulsion: Reaction Motors (liquid prepack)
Remarks: Bulova Research Lab., Texas Inst., Horkey - Moore, Douglas, Talco Eng., Williamson Co., Emerson, and ACF are all sub-contractors.

CROSSBOW

Service: Air Force
Type: Air-to-surface
Status: Design

Physical Data

No data available
Remarks: No contract activity in last year. Being developed as countermeasure or destructive weapon. Range 200 mi.

Contractors

Airframe: Radioplane
Guidance: Nortronics, Bendix
Propulsion: Westinghouse (turbojet)
Warhead: Countermeasure.

Classified

DELTA

Service: NASA
Type: Space Research
Status: Development

Physical Data

Height: 91 ft
Diameter:
Weight: 112,000 lb
Remarks: First stage Thor, 2nd Aerojet AJ-10-118, 3rd Allegheny ABL-X-248-A5 "Delta".

Contractors

Airframe: Douglas
Guidance: Bell Telephone Labs
Propulsion: Aerojet, Allegheny Ballistics
Payload: 500 lb in 300 mi Earth orbit, or 65 lb in Moon orbit.
Remarks: Missile is NASA's attempt to come up with cheaper research vehicle as predecessor to Centaur and other long lead time vehicles.

Classified

DYNASOAR

Service Air Force
Type: Orbital glider
Status: Design

Physical Data

Height: Over 100 ft
Diameter: Same as Saturn
Remarks: Boeing - Martin team were to work on vehicle and booster respectively. New proposal shown in diagram is to use modified X-15 with first two stages of Saturn.

Contractors

Nothing firmed up.
Airframe: Boeing, NAA (proposed)
Guidance: Sperry, GE
Propulsion: Aerojet, Reaction Motors, P&W, Rocketdyne
Vehicle: X-15, Boeing glider
Remarks: Drawing is A&M artist's concept of one DynaSoar proposal.

EAGLE

Service: Navy
Type: Air-to-air
Status: development (early)

Physical Data

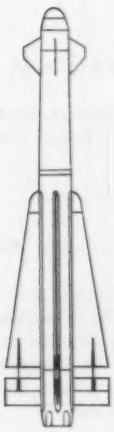
Height: 15-20 ft (est)
Diameter: 2 ft (est)
Weight: 2000 lb (est)
Remarks: Range 100 mi at M3. To be carried on Navy Missileer

Contractors

Airframe: Bendix Aviation, Grumman
Guidance: Bendix, Westinghouse, Litton, Ind.
Propulsion: Thiokol
Warhead: Neclear
Remarks: Lots of contract potential

FALCON 1-2

Service: Air Force
Type: Air-to-air
Status: Production



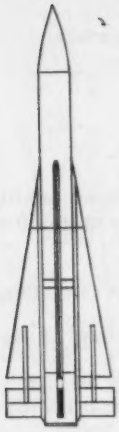
Physical Data

Height: 6 ft 5.8 in.
Diameter: 6.5 in.; span 20 in.
Weight: 115 lb (approx.)
Remarks: Range 5 mi at M 2.5. GAR-1 is semi-active homing. GAR-2 infrared

Contractors

Airframe: Hughes
Guidance: Hughes
Propulsion: Thiokol
Warhead: General Sintering (fuzing)
Remarks: Being replaced by GAR-3, 4 & 9.

FALCON 3-4-9



Service: Air Force
Type: Air-to-air
Status: Production

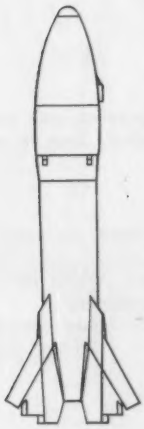
Physical Data

Height: 7 ft 5 in.
Diameter: 6.5 in., span 26 in.
Weight: 150 lb
Remarks: Over 5 mi range at Mach 2.5. Total deliveries of Falcon exceed 15,000 rounds

Contractors

Airframe: Hughes
Guidance: Hughes (MA-4)
Propulsion: Thiokol
Warhead: GAR-9 Sandia Corp.
Remarks: Greater thrust, longer burning time over original Falcon. Production runs as high as 100/week

GENIE



Service: Air Force, RAF
Type: Air-to-air
Status: Production

Physical Data

Height: 8 ft long
Diameter: 15 in.
Weight: 900 lb
Remarks: Carried on F-89, F-101, F-106, P1B Range, 1.5 mi at M4.

Contractors

Airframe: Douglas
Guidance: Hughes (MG-12 fire control)
Propulsion: Aerojet-General, Panda Electronic (fuze)
Warhead: Nuclear, 1.5 KT
Remarks: In considerable inventory. Missile costs $7,000, warhead costs $250,000. Fruehauf makes positioning trailer.

Classified

GIMLET

Service: Navy
Type: Air launch
Status: Development

Physical Data

Height:
Diameter:
Weight:
Remarks:

Contractors

Airframe:
Guidance: none
Propulsion: Hunter Douglas
Warhead:
Remarks:

HAWK

Service: Army, Marines
Type: Surface-to-air
Status: Production

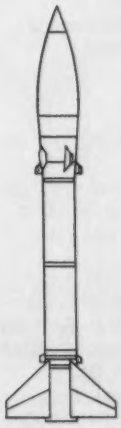
Physical Data

Height: 16.8 ft
Diameter: 14 in.; span 48 in.
Weight: 1275 lb
Remarks: Homing guidance, solid propellant. Low-level (100 ft) missile. Range 20 mi.

Contractors

Airframe: Raytheon, Northrop, Temco
Guidance: Raytheon
Propulsion: Aerojet, Norris Thermidor (case)
Warhead: Picatinny Arsenal
Remarks: Food Machinery & Chemical, Eclipse Pioneer, Goodyear have ground support

HONEST JOHN



Service: Army
Type: Surface-to-surface
Status: Production

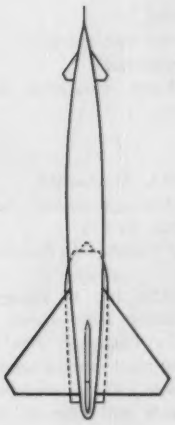
Physical Data

Height: 27 ft
Diameter: 30 in.
Weight: 5800 lb
Remarks: Warhead is nuclear or conventional, Range 12 mi.

Contractors

Airframe: Douglas, Emerson Elect.
Guidance: None
Propulsion: Thiokol, Hercules
Warhead: 762 mm atomic
Remarks: Rock Island Arsenal has ground support

HOUND DOG



Service: Air Force
Type: Air-to-ground
Status: Production

Physical Data

Height: 42 ft long
Diameter: 12-ft span
Weight: 11,000 lb
Remarks: First fired from B-52 in April 59. Range is 500+ mi at M 1-0

Contractors

Airframe: North American Aviation
Guidance: NAA Autonetics
Propulsion: P&W (J-52)
Warhead: Sandia Corp., (nuclear-20MT)
Remarks: Self contained, little support equipment necessary; Coleman Eng. and Space Corp. have some contracts.

JUPITER

Service: Army
Type: 1RBM (1500 mi)
Status: Production

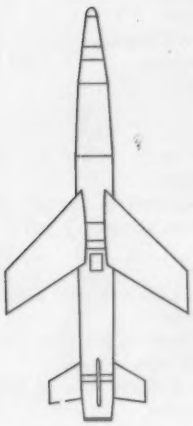
Physical Data

Height: 60 ft
Diameter: 105 in.
Weight: 110,000 lb
Remarks: Thrust is 150,000; guidance, all inertial

Contractors

Airframe: Chrysler, ABMA
Guidance: Ford Instrument, Motorola
Propulsion: Rocketdyne
Warhead: CTL, Goodyear (nose cone shield)
Remarks: Chrysler, General Mills, Fruehauf, Gamm Trailer, Watertown Arsenal, have ground support

LACROSSE



Service: Army
Type: Surface-to-surface
Status: Production

Physical Data

Height: 19 ft
Diameter: 20.5 in.; 108 in. span
Weight: 2300
Remarks: Command guidance. Range 20 mi at M2.0. Developed by Cornell Labs.

Contractors

Airframe: Martin-Orlando
Guidance: Federal Tel Labs
Propulsion: Thiokol-Redstone
Warhead: Solar, GE
Remarks: Annual resupply costs to be about $400,000

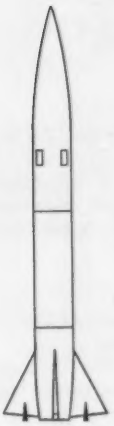
LITTLE JOE

Service: NASA
Type: Mercury test launch
Status: Development
Remarks: Eight clustered solid propellants

Contractors

Airframe: NAA, McDonnell
Guidance: Minn.-Honeywell, Lear, Waste King, Sperry
Propulsion: Thiokol 4 Pollox, 4 Recruit
Remarks: Little Joe is designed to test boiler plate mock up of Mercury capsule. The design of the pilot escape system was proven. Atlas, Redstone, Jupiter tests will also be run. Not illustrated in this directory.

LITTLE JOHN



Service: Army
Type: Surface-to-surface
Status: Production

Physical Data

Height: 14.5 ft
Diameter: 12.5 in.
Weight: 800 lb
Remarks: Unguided artillery weapon. Range up to 30 mi.

Contractors

Airframe: Emerson Elect, Douglas
Guidance: None
Propulsion: Alleghany Ballistics Lab.
Warhead: Picatinny Arsenal
Launchers: Rock Island Arsenal

LOKI

Service: Army
Type: Surface-to-air
Status: Production-operation

Physical Data

Height:
Diameter:
Weight:
Remarks: No guidance, one solid propellant rocket, fired in salvos

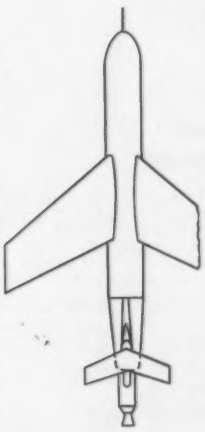
Contractors

Airframe: East Coast Aeronautics
Guidance: none
Propulsion: Grand Central Rocket
Warhead: (conventional)
Remarks: Bendix holds contract for launchers

Classified

MACE

Service: Air Force, NATO
Type: Surface-to-surface
Status: Production



Physical Data

Height: 40 ft long
Diameter: 29 ft span
Weight: 14,000 lb (no booster)
Remarks: Range 600+ mi at 35,000 ft, M 0.9 for low-level run in. Cost $150,000

Contractors

Airframe: Martin
Guidance: Goodyear, ATRAN; AC Spark Plug, Inertial
Propulsion: Thiokol (solid booster) Allison (J-33)
Warhead: Nuclear
Remarks: Goodyear builds Translauncher, Four Wheel Drive makes prime mover.

MINUTEMAN

Service: Air Force
Type: ICBM (5500 mi)
Status: Development

Physical Data

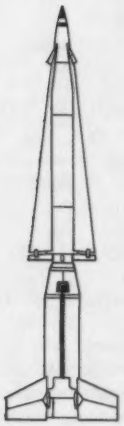
Height: 55 ft
Diameter: 5 ft
Weight: 80,000 lb
Remarks: 2nd generation, 3 stages. To be stored, fired from hard silos, and mobile platforms

Contractors

Airframe: Boeing
Guidance: NAA Autonetics (180-lb inertial)
Propulsion: Thiokol, 1st; Aerojet, 2nd & 3rd
Warhead: Avco (nose cone)
Remarks: Utility Trailers, Radiation Inc., Beech, United Electrodynamics have special ground equipment.

NIKE HERCULES

Service: Army
Type: Surface-to-air
Status: Production



Physical Data

Height: 39 ft (with booster)
Diameter: 31.5 in.; span 90 in.
Weight: 10,000 lb (with booster)
Remarks: Range 20 mi at M 3.3. Radio-command guidance

Contractors

Airframe: Western Elec., Douglas
Guidance: Bell Tel Labs.
Propulsion: Thiokol, Borg-Warner
Warhead: Sandia Corp., GE Instrumentation, Avco (nose cone)
Remarks: Douglas, AMF, Western Elec. Fruehauf, ground support

NIKE ZEUS

Service: Army
Type: Anti-missile
Status: Development

Physical Data

Height: 55 ft with booster
Diameter: 90 in. (est)
Weight: 20,000 lb with booster
Remarks: Command, guidance, range about 200 mi at M 7.0

Contractors

Airframe: Western Electric, Bell Tel Labs., Douglas
Guidance: Western Electric, Bell Tel Labs.
Propulsion: Thiokol, Hercules
Warhead: Sandia Corp.
Remarks: Douglas has ground support. Could have tremendous contract potential. $590 million now obligated.

NOVA

Service: NASA
Type: Satellite launcher
Status: Design

Physical Data

Height: 275 ft (est)
Weight: 4,500,000 lb (est)
Remarks: Up to 5 stages. Could orbit 75 ton "space lab" at 300 mi or soft land 10 tons on moon

Design Data

Stage 1: Four 1.5 million lb F-1 engines
Stage 2: One 1.5 million F-1 engine
Stage 3: One 80,000 lb liquid H_2 engine
Stage 4: One 40,000 lb liquid H_2 engine
Stage 5: One 6000 lb storable liquid

PERSHING

Service: Army
Type: Surface-to-surface
Status: Development

Physical Data

Height: 35-40 ft
Diameter: 6 ft (est)
Weight: 32,000 lb (est)
Remarks: Range 500 mi, inertial guidance, nuclear warhead. 2nd generation missile, will replace Redstone.

Contractors

Airframe: Martin
Guidance: Bendix-Teterboro
Propulsion: Thiokol-Redstone
Warhead: Sandia Corp. (nuclear)
Remarks: Thompson Ramo-Wooldridge, transporter-erector

POLARIS

Service: Navy
Type: IRBM (1800 mi)
Status: Development

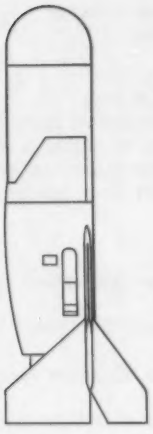
Physical Data

Height: 28 ft
Diameter: 4.5 ft
Weight: 28,000 lb
Remarks: 2-stage solid missile, 16 will be carried in each of 9 nuclear submarines. Thrust is about 100,000 lb.

Contractors

Airframe: Lockheed
Guidance: MIT, GE (missile); Autonetics, Sperry (ship)
Propulsion: Aerojet 1st, Aerojet & Thiokol 2nd
Warhead: GE (nosecone), AEC
Remarks: Interstate Electronics. Tremendous contract potential.

QUAIL



Service: Air Force
Type: Air launch (diversionary)
Status: Production

Physical Data

Height: 13 ft long (approx)
Diameter: 1.5 ft; 5.6 ft span (approx)
Weight: 1,200 lb
Remarks: Range 200 mi at M 0.9. Made almost entirely of reinforced plastics.

Contractors

Airframe: McDonnell ($45 million)
Guidance: Summers Gyroscope
Propulsion: GE (J-85)
Warhead: Counter measures
Remarks: Designed to make B-52 and B-47 "invisible" to radar.

SCOUT

Service: NASA, UK
Type: Satellite launcher
Status: Design

Design Data

Stage 1: Aerojet Senior
Stage 2: Improved Sergeant
Stage 3: Scaled-up 3rd stage Vanguard
Stage 4: Improved ABL X-248

Contractors

Airframe: Chance Vought
Guidance: Minn.-Honeywell
Propulsion: Aerojet, Allegheny Ballistic Lab, Thiokol
Remarks: UK will use vehicle beginning in 1961. Should be in use at NASA by late 1960.

REDEYE

Service: Army, Marines
Type: Surface-to-air
Status: Production

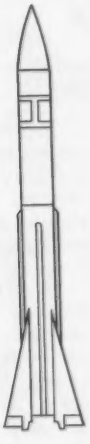
Physical Data

Height: 45 in. long
Diameter: 3-4 in.
Weight: less than 20 lb
Remarks: Shoulder-fired, bazooka type weapon, fired against low aircraft.

Contractors

Airframe: Convair
Guidance: Heatseeker
Propulsion: Army Arsenals
Warhead: High explosive
Remarks: Convair known to have over $6 million as prime.

SERGEANT



Service: Army
Type: Surface-to-surface
Status: Production

Physical Data

Height: 30 ft
Diameter: 31 in.
Weight: 11,000 lb
Remarks: Range 75 mi at M 3.5 under 50,000 lb solid thrust.

Contractors

Airframe: Sperry-Utah, JPL ($42 million)
Guidance: Sperry, Minn.-Honeywell, Lear
Propulsion: Thiokol
Warhead: Conventional, nuclear
Remarks: Air transportable. Has unique self-leveling launcher.

SATURN

Service: NASA
Type: Satellite launcher
Status: Design

Physical Data

Height: 200 ft (est)
Weight: 1,160,000 lb
Remarks: Orbit 19,900 lb at 300 mi; 3,300 lb at 24,000 mi. First launch in 1963.

Design Data

Stage 1: Eight 187,500 lb H-1 engine
Stage 2: Twin chamber Titan 1st stage
Stage 3: Two 150,000 liquid H_2
Stage 4: XLR-115 liquid H_2
Remarks: Will receive big portion of NASA vehicle-budget. President Eisenhower mentioned in budget speech. Convair prime.

Classified

SHILLELAGH

Service: Army
Type: Surface-to-surface
Status: Development

Physical Data

Height:
Diameter:
Remarks: Light-weight missile for close-in support of troops. May be renamed "Pentomic."

Contractors

Airframe: Ford Aero Div.
Guidance: Raytheon
Propulsion: Ordnance Tank Automotive Command
Warhead: Army Arsenals
Remarks: Should be operational by mid-1960. Total of about $25 million let.

SIDEWINDER

Service: Navy, Air Force, NATO
Type: Air-to-air
Status: Production

Physical Data

Height: 9 ft
Diameter: 5 in.
Weight: 155 lb
Remarks: Heat seeker, pilot must lock on target. 5000 yd at M 2.5.

Contractors

Airframe: Philco, GE, Norris Thermador, Hunter Douglas
Guidance: Philco, Electronics Corp. of America
Propulsion: Naval Powder Factory
Warhead: Bulova, Eastman Kodak, Hamilton, Minn.-Honeywell, Elken

SIDEWINDER-1C

Classified

Service: Navy, AF, NATO
Type: Air-to-air
Status: Development

Physical Data

Height:
Diameter:
Weight:
Remarks: 2nd generation model of original Sidewinder. Testing at China Lake.

Contractors

Airframe: Philco
Guidance: } Believed same as
Propulsion: } Sidewinder 1A
Warhead: }

SKY BOLT

Classified

Service: Air Force
Type: Air-to-surface (ALBM)
Status: Design

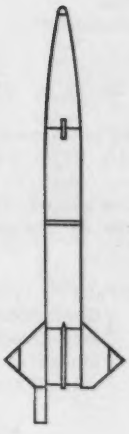
Physical Data

Height:
Diameter:
Weight:
Remarks: Originally Bold Orion and ALBM. Range 1000 mi, launched from B58 and B52 at 40 to 50 deg from horizontal.

Contractors

Airframe: Douglas
Guidance: Nortronics or GE
Propulsion: Aerojet-General
Warhead: GE (nose cone), (nuclear)
Remarks: Could be one of Air Force's biggest new programs in 1960, or could flop.

SKYDART



Service: Air Force—ARDC
Type: Target missile
Status: Production

Physical Data

Height: 6.6 ft long
Diameter: 20.8-in. span
Weight: 50-100 lb
Remarks: Used as a rocket powered aerial target for Sidewinder and Falcon missiles. Flare on tail gives 90 sec target source.

Contractors

Airframe: Curtiss-Wright
Guidance: None
Propulsion: Grand Central & dual-solid)
Warhead: None
Remarks: Being built at Santa Barbara Div. About $470,000 has been let initially.

SLAM

Classified

Service: Air Force
Type: Surface-to-surface
Status: Early development

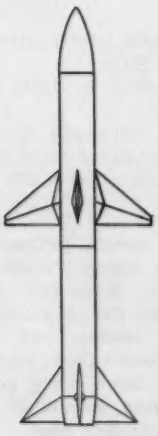
Physical Data

Height: } No physical data
Diameter: } available
Remarks: Low-altitude, supersonic ramjet with nuclear powerplant. Preliminary work done in project Pluto. Industry studies also known as BOLO and BIG STICK.

Contractors

Airframe: Convair
Guidance: Chance Vought
Propulsion: Marquardt
Warhead: AEC (nuclear)

SPARROW III



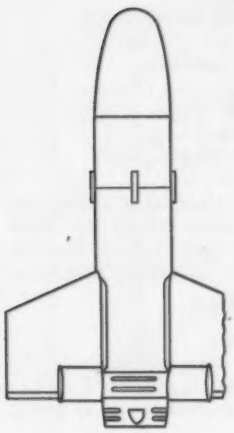
Service: Navy
Type: Air-to-air
Status: Production

Physical Data

Height: 12 ft long
Diameter: 8 in.; span 40 in.
Weight: 380 lb
Remarks: Range 5 mi at M 2.5. Liquid prepack replaces solid

Contractors

Airframe: Raytheon
Guidance: Raytheon
Propulsion: Reaction Motors
Warhead: Corning Glass, Elgin Watch, Naval Ord. Lab.
Remarks: Electronic controlled homing



SS-10, SS-11

Service: Army, NATO
Type: Anti-tank
Status: Production

Physical Data

Height: SS-10, 34 in.; SS-11, 46 in.
Diameter: 6.5 in. (approx.)
Weight: SS-10, 33 lb; SS-11, 64 lb
Remarks: Wire guided. Over 23,000 rounds already produced.

Contractors

Airframe: Nord-Paris
Guidance: Government operated
Propulsion: Direction des Etudes et Fabrications D'Armement
Warhead:

Classified

SUBROC

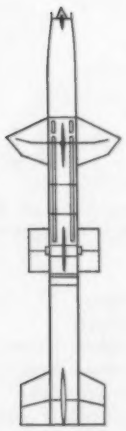
Service: Navy
Type: Surface-to-underwater
Status: Development

Physical Data

Not Available
Remarks: Has aerodynamic and hydrodynamic surfaces.

Contractors

Airframe: Goodyear ($65 million)
Guidance: Kearfott Librascope
Propulsion: Aerojet/General, Thiokol
Warhead: Nuclear
Remarks: Advanced tactical missile for destroying submarines. Can be fired from underwater as well as surface.



TALOS

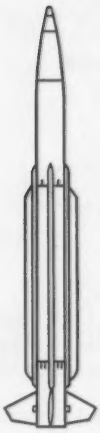
Service: Navy
Type: Surface-to-air
Status: Production

Physical Data

Height: 30 ft (with booster)
Diameter: 30 in.
Weight: 3000 lb, 7000 lb with booster
Remarks: Developed by Applied Physics Lab. of Johns Hopkins. Range 65 mi, at M 2.7.

Contractors

Airframe: Bendix, McDonnell
Guidance: Sperry, Farnsworth
Propulsion: McDonnell (ramjet) Allegheny Ballistics Lab.
Warhead: Nuclear and conventional Sandia Corp., Melpar Inc.
Remarks: Beam riding guidance, GE makes electric lift to get missile to deck level.



TARTAR

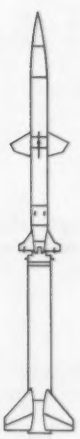
Service: Navy
Type: Surface-to-air
Status: Production (pilot)

Physical Data

Height: 15 ft (est)
Diameter: 3 ft-5 in. span
Weight: 1500 lb
Remarks: Range 12 mi at supersonic speed. Advanced Terrier. Beam rider

Contractors

Airframe: Convair
Guidance: Sperry, Reeves, Western Electric
Propulsion: Aerojet-General
Warhead: Corning Glass, Diamond Ordnance Lab.
Remarks: Production contract about $35 million



TERRIER

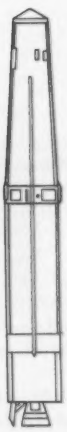
Service: Navy, NATO
Type: Surface-to-air
Status Production

Physical Data

Height 15 ft, 27 ft with booster
Diameter 13 in., span 3 ft-10 in.
Weight: 3000 lb with booster
Remarks: Range about 10 mi under solid booster at M 2.5

Contractors

Airframe: Convair
Guidance: Sperry, Reeves Western Electric
Propulsion: Allegheny Ballistics Lab.
Warhead: Corning Glass, Diamond Ordnance Lab.
Remarks: Radar beam seeking guidance



THOR

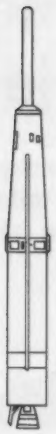
Service: Air Force, UK
Type: IRBM (1500 mi)
Status: Production

Physical Data

Height: 65 ft
Diameter: 8 ft
Weight: 110,000 lb
Remarks: Liquid rocket and two verniers produce over 150,000 lb thrust. Over 65 rounds fired

Contractors

Airframe: Douglas
Guidance: AC Spark Plug (inertial)
Propulsion: Rocketdyne, main and vernier
Warhead: GE (Mk-2 nose cone)
Remarks: Food Machinery makes transporter/erector



THOR-ABLE

Service: NASA
Type: Satellite launcher
Status: Development

Physical Data

Height: 90 ft
Diameter: 96 in. at base
Weight: 110,000 lb
Remarks: Three stages, Launched Explorer VI. Deep space probe.

Contractors

Airframe: Douglas, Space Tech Labs.
Guidance: GE-MSVD
Propulsion: Rocketdyne 1st, Aerojet 2nd, ABL 3rd.
Warhead: Instrumentation by various contractors.

Classified

WAGTAIL

Service: Air Force
Type: Air-to-surface
Status: Design

Physical Data

Height:
Diameter:
Weight:
Remarks: Range, probably over 25 mi. Being developed to follow terrdin at low levels

Contractors

Airframe: Minn.-Honeywell
Guidance: Minn.-Honeywell
Propulsion: not awarded
Warhead: Sandia Corp., Minn.-Honeywell

THOR-HUSTLER

Service: NASA
Type: Satellite launcher
Status: Development

Physical Data

Height: 78 ft-3 in.
Diameter: 96 in. at base
Weight: 108,500 lb
Remarks: Launching series of discoverer vehicles.

Contractors

Airframe: Douglas
Guidance: GE-MSVD
Propulsion: 1st Rocketdyne, 2nd Bell
Payload: GE, B. F. Goodrich (nose cone)
Remarks: MIDAS, and SAMOS projects closely tied in to this program.

WEAPON ABLE

Service: Navy
Type: Surface-to-underwater
Status: production

Physical Data

Height: 8.5 ft
Diameter: 12.75 in.
Weight: 500 lb
Remarks: Fired from destroyers against submarines

Contractors

Airframe: Avco
Guidance: None
Propulsion: Naval Ordnance Lab.
Warhead: Naval Ordnance Lab.

TITAN

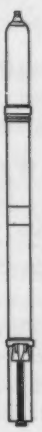
Service: Air Force
Type: ICBM
Status: Development

Physical Data

Height: 90 ft
Diameter: 1st, 10 ft; 2nd 8 ft
Weight: 220,000 lb
Remarks: To be fired from hard sites. 1st stage tests good, 2nd stage bad. Martin reorganized whole program.

Contractors

Airframe: Martin ($385 million)
Guidance: MIT, AC Spark Plug
Propulsion: Aerojet, 1st & 2nd
Warhead: Avco (nose cone, $210 million)
Remarks: AMF chief launch equipment contractor has over $100 million. Kaiser Steel makes erector.



ZUNI

Service: Navy
Type: Air-to-surface
Status: Production

Physical Data

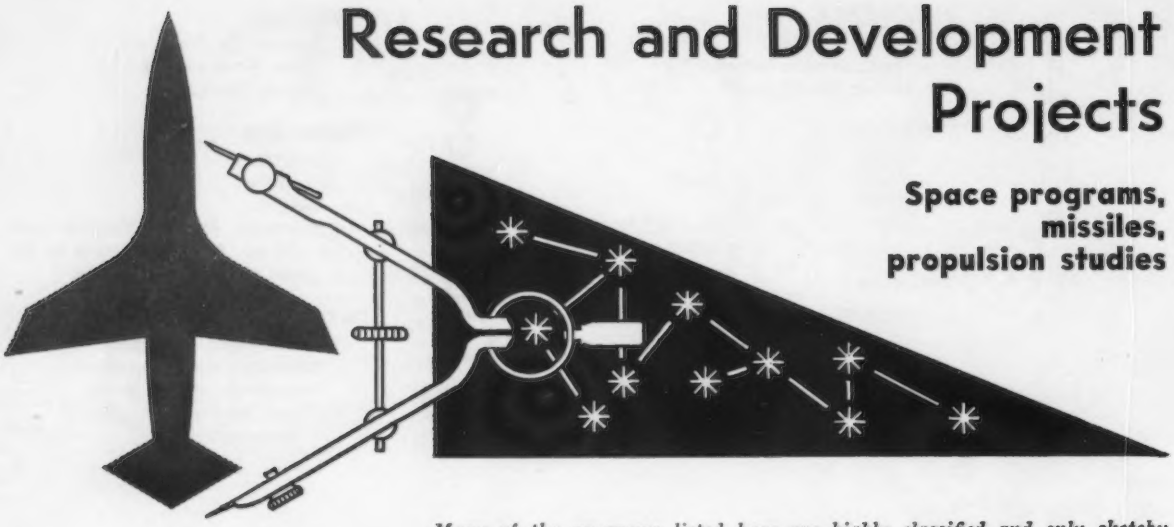
Height: 110 in.
Diameter: 5.0 in.
Weight: 107 lb
Remarks: Can be armed with various warheads.

Contractors

Airframe: Bridgeport Brass
Guidance: None
Propulsion: Naval Ordnance Lab.
Warhead: Lansdowne Steel & Iron
Remarks: To replace HVAR

Research and Development Projects

Space programs, missiles, propulsion studies



Many of the programs listed here are highly classified and only sketchy information is available. But, these programs are indicators of strategy and advanced planning. Knowledge of them is essential to companies thinking of a future in aerospace.

ABLE—Army missile for direct support to battle group. Lightweight, with high degree of accuracy and mobility. Feasibility studies at Armour, Cornell Aeronautical Lab., General Electric, Minneapolis-Honeywell, Martin, Douglas Army.

ABLE-STAR—Vehicle to be used with Thor booster for launching Courier and Transit satellites. Space Technology Labs is prime; Aerojet General heads propulsion team.

AEROSCORE "C" — Optic-electronic system for measuring trajectories of missiles. Installed in drones. Aerojet-General.

AGENA—Slated for use as second stage with Atlas and Thor. Air Force plans to use it to place large payloads into Earth and Moon orbits. Was used as Thor second stage in Discoverer program, and attained first polar orbit. Lockheed builds the vehicle, Bell the engine. Formerly under ARPA's Project Tribe.

AGILE — Navy air-to-air missile. Bendix, Grumman.

ALRI—Airborne Long Range Input. Seaward extension of SAGE system by radar station in an RC-121 aircraft.

AN/AMQ-15 — Weather Reconnaissance Systems Program; begun in September, 1958. May be integrated into multijet aircraft. Bendix, Boeing.

AP-2—Follow on to Polaris with 3000 mi range. Proposal stage. Lockheed.

ARCAS—Navy atmospheric research rocket, using solid propellant, for lifting 12-lb payload to 200,000 ft. Parachute-recoverable. Atlantic Research.

ARCON—Navy solid-propellant research rocket. Can lift to 40 lb to 70 miles. Atlantic Research.

ARM (WS-121B)—Anti-radar missile, believed air-to-ground. Air Force.

ASROC — Anti-submarine rocket. Launched underwater. Covers most of distance through air, then reenters water to seek its target by acoustical homing. Solid propellant. Replaces Rat. Minneapolis-Honeywell, Sandia, Universal Match.

ASTOR — Anti-submarine torpedo ordnance rocket. Water and air trajectory. Based on vehicle the size of a Mark 18 torpedo. Nuclear warhead. Westinghouse.

ASTRO—Artificial Satellite Time and Radio Orbit. Name for navigational satellite.

ASTRONOMICAL OBSERVATORIES—NASA basic research program for mounting telescopes on stabilized orbital platforms. Telescopes will study X-ray, ultraviolet and infrared radiations from sun and stars. Preliminary study contracts have been awarded to a number of universities. NASA is considering proposals on further research. First orbiting observatories are expected within five years.

ATLANTIS—Navy program for underwater defense line against enemy subs.

ATOMIC CLOCK—NASA Project to test Einstein's General Theory of Relativity by comparing atomic clock in satellite with atomic clock on earth. Clock, using ammonia, being developed by Hughes Aircraft. Clock with cesium being developed by National Bureau of Standards. Study contract held by MIT. Target date on project: 1961.

AUTOMET—Proposed solid propellant close-support missile for Army use.

AZUSA—Integration system. Electronic tracker of missiles used on all major missile shots. Predicts course and impact area. Mark II system now coming into being. Convair.

BDM (WS-126A) — Bomber Defense Missile; design adapted from Hawk. General Electric, Raytheon, Hughes.

BIG STICK—Nuclear-ramjet missile. Air Force, Convair.

BMEWS—Ballistic Missile Early Warning System with 3000-mi range radar screens. Bases will be at Thule, Greenland; Clear, Alaska; and Scotland.

BOLO—North American's nuclear-ramjet missile. Air Force.

BOMBARDMENT — Air - to - air missile being developed by North American and the Air Force.

CENTAUR — Atlas with liquid-hydrogen second stage. Vehicle could orbit 10,000-lb weather or communication satellites; and soft-land 730-lb payloads on the moon. Convair is prime and Pratt & Whitney supplies the liquid-hydrogen engines. First firing is slated for early next year under NASA direction.

CHOPPER JOHN—Army helicopter-launched version of Honest John missile.

CLAYMORE—Secret Army project, reportedly an anti-personnel missile.

COSMOS — Aerojet-General proposal for liquid-fueling boosters ranging from six to 14-million-lb thrust.

CREE—Air Force research rocket for aircraft escape capsule ejection at high altitudes. Cook Research Lab.

DAVY CROCKETT—Army tactical missile to be fired from bazooka-type weapon. Martin.

DEFENDER—Entire ARPA effort in ballistic missile defense. Planning extends to about 1980. Project consists of over 50 programs. These include Esar, flexible ground-based radar; Glipar, a missile defense study group; Pincushion, many-frequency radar to be located on Kwajalein in the Marshall Islands; and Tradex, advanced version of BMEWS radar.

DELTA—NASA space launch vehicle for 1960-62. Three stage. Douglas is prime, providing Thor first stage.

DERVISH—Initially developed as replacement for Mighty Mouse. Subsequently proposed to Army. Program partly reactivated by Army in late '58. Spin-stabilized, solid propellant. Northrop, Thiokol.

DIAMOND - BACK — Improved version of Sidewinder; will be identified as SARAH. May be fitted with liquid-packaged propellants. Naval Ordnance Test Station, Philco.

DOORKNOB—Test rocket, being developed in single and two stage versions by Sandia Corp.

DUCK — Bombardment defense missile for armament of long-range and supersonic bombers. Des: WS-102 A/L. Fairchild.

ECHO—Experimental passive communications satellite slated for orbit this Spring. NASA project uses a 100-ft diam aluminized Mylar sphere which is inflated in space after launching by Delta vehicle.

EX-8—Anti - submarine, rocket-powered torpedo missile. Speeds may exceed 150 knots. Reportedly a new method of cavitation. Control has been developed to decrease drag and noise. Aerojet-General, Bendix.

EXOS — Air Force experimental project to measure cosmic ray intensities from ground level to rocket ceiling. Total pulse or count rate per sec will be relayed to a ground station.

F-1—Single chamber rocket engine designed to produce 1.5 million-lb thrust. North American heads development under Nova program.

FIREFLY—Guided missile for fire-fighting. In R&D at Solar Aircraft.

GNAT—Navy surface-to-air rocket. Naval Ordnance Lab.

GREBE—Navy air-to-surface missile.

HARE—Missile that would fly on fuel scooped from atmosphere. Oxygen would be rendered atomic by ultra-violet radiation into individual atoms.

HAS—Multi-stage test vehicle of seven Viper engines and one Nike or Lance. This $30,000 recoverable vehicle could carry 60 lb payload 500 miles high. Sandia.

HERO—Navy BuWeap project exploring electromagnetic radiation and its relation to storing, handling and delivering missiles.

HETS—High environmental test system to give Air Force a low cost means of testing ballistic missile equipment at low altitudes and eventually sending payloads to the moon.

HOPI—Navy medium-range air-to-surface missile for carrier-based aircraft with nuclear capability. Naval Ordnance Test Station.

HOT POINT—For anti-aircraft bombing. Can also be employed against marine targets. Nuclear warhead. Navy.

HUGO—Long range project for improved weather prediction. Nike-Cajun rocket used to thrust 38-lb instrument package close to 100 mi high. Camera (70 mm) then photographs cloud cover over about 500,000 sq mi. Project is sponsored by the ONR and the Weather Bureau.

IRIS—Navy, sounding rocket similar to Aerobee-Hi. Has solid fuel, can take 100-lb payload to 200 miles altitude. Weighs 1000 lb, is

Over 120 aerospace projects have been actively researched; Some now dormant because of funding difficulties

15-ft long and has 12-in. diam. Atlantic Research.

JAGUAR—Test program exploring capability of air-launched sounding rocket operations in remote areas. Four-stage rockets are designed to send instrumented payloads over 500 mi high. NASA.

JULIE—Underwater detection system firing small explosive charges from aircraft or submarines. In advanced development under Daystrom Inc. and Western Electric's Bell Telephone Labs.

KATIE — Navy surface-to-surface and anti-sub torpedo launched by 16-in. guns. Has nuclear capability.

KINGFISHER—Air Force diversionary supersonic drone, 38-ft long. Launched from B-52 bomber. Lockheed.

LAZY DOG—Air Force air-to-surface missile launched from low flying aircraft as anti-personnel missile. Very small.

LOBBER—Proposed solid propellant supply missile. 35 lb, reuseable. Convair.

LOKI—Army surface-to-air unguided rocket. Has solid charge, and three-inch diam. Bendix, East Coast Aeronautics, Grand Central Rocket.

LONGSIGHT — ARPA program for conceptual studies and exploratory research on advanced weapons and weapon systems.

LULU—Navy project for an anti-sub missile with a nuclear warhead.

MADRE—Radar system capable of seeing over the horizon. Developed by Naval Research Lab. Bounces relatively low frequency signals off the ionosphere, stores and compares them on magnetic-drum receiving equipment.

MARK 44—Navy rocket-assisted anti-sub torpedo launched from aircraft. General Electric.

MARK 46—Navy anti-sub torpedo with radar-homing device. Aerojet-General.

MAULER — Army surface-to-air weapon, against low-flying aircraft. Infrared guidance. Convair, General Electric, Martin, Raytheon, Sperry.

MERCURY—Top priority NASA project to develop a life-sustaining capsule capable of being fired into orbit and returned safely to Earth. Program will study psychological and biological aspects of space environment; costs are expected to exceed $275 - million. Preliminary 200-mile flights in Redstone missiles are slated for this summer; first manned orbit may come next year. McDonnell is prime contractor. Convair supplies the Atlas boosters. Other firms in the program: Collins Radio, communications systems; Thiokol, retro-rockets; Grand Central Rocket, escape rockets; Minneapolis-Honeywell, stabilizers and control systems; Bell Aircraft, hydrogen peroxide jets; Perkin Elmer, periscope system; Minneapolis-Honeywell, stabilizers and control; Chrysler, Redstone boosters.

METEOR—NASA project studying effects on plasma sheath on objects re-entering atmosphere.

METHUSELAH (X-7A3) — Air Force surface-to-surface experimental ramjet testing vehicle.

MIDAS — Missile Defense Alarm Satellites for detecting enemy ICBM launchings. Project calls for about six satellites in pole-to-pole orbits. These would detect infrared radiation from blast-off. Over $300- million will have been spent on Midas by the end of FY 1960. Project was transferred from ARPA to the Air Force last year. Lockheed Missile Systems Div., is prime.

MINITRACK — Radar - tracking network for satellites. NASA will spend $4.75 million in fiscal '61.

MISSILE B & MISSILE C—Army missiles under study as improvements over Honest John and Little John support weapons.

MISSILE D—Pershing, developed as tactical replacement for Redstone. Army.

MRS. V—Study contract of maneuverable, recoverable space vehicles. ARPA no longer developing and there has been no official reassignment.

NIMBUS—Meteorological satellite project, to follow NASA's TIROS series. Thor Agena (B) will boost a 650-lb satellite into a 600-mile polar orbit for weather observation by infrared, television, and other techniques.

NOTUS — Entire communications satellite project including Task Courier, Task Steer, and Task Decree. Funded and managed by ARPA though slated for eventual transfer to the Army. Was budgeted for $170-million in Fy 1960.

NOVUS — Grand Central Rocket Co. proposal for a 14.4-million-lb-thrust solid propellant booster composed of six clustered 2.4-million-lb-thrust-boosters.

ORION—ARPA program for using controlled nuclear pulses for space vehicle propulsion. Feasibility study conducted by General Atomic, div. of General Dynamics. Part of Project Longsight.

PLUTO—Program to demonstrate feasibility of high-temperature air-cooled reactors for ramjets. University of California's Lawrence Radiation Lab is conducting research for AEC. Atomics Inter-

national, div. of North American Aviation, has aided in materials problems.

PONTUS—ARPA R&D program through U. S. universities to obtain major improvements in structural and power conversion materials.

PRESS—ARPA experiments to determine efficiency of radar to detect and identify ballistic missile warheads. Part of Project Defender.

PRINCIPIA — ARPA R&D program to obtain a solid propellant with 10 to 20 per cent greater specific impulse than any now known.

PROJECT FIRE — Part of projected family of Army short range missiles. Length about 12 ft. Liquid rocket motor. Chance - Vought, North American Aviation.

RAVEN—Proposed air-to-surface 500-mile-range missile now under study by the Navy.

ROVER—Nuclear rocket program. Los Alamos Scientific Laboratory and Atomics International are conducting work for the AEC. Program uses KIWI-A reactor, advanced models of which may generate 100,000 lb thrust.

SAGE — Semi-Automatic Ground Environment air warning system which will operate in at least 20 sites; now operational in five. Air Force.

SAMOS—System of optical reconnaissance satellites being developed by Lockheed for the Air Force. First R&D version may be launched this month. Camera in satellite is gimballed for pointing; activated by radio command from ground station. Sighting is reportedly through elliptical window measuring about 12 in. along major axis. Project was originally named Sentry.

SARAH—Proposed new version of Sidewinder. Will include an all-electronic guidance system. To be used on missions where weather or other considerations might hamper infra-red guidance. Motorola, Texas Instruments.

SARUS—Search and Rescue Using Satellites for relaying messages from lost or stranded vehicles.

SHEPHERD — ARPA project for development of a satellite detection and tracking system including a National Space Surveillance Control Center.

SKOKIE — Air-launched parachute test vehicle. Air Force. Cook Electric.

SLAM—Supersonic low altitude missile being studied at Chance Vought. It would use nuclear ramjet propulsion system similar to Pluto.

SLIM—Navy's underwater-to-air-to-underwater missile. Convair.

SNAP—Systems for Nuclear Auxiliary Power being developed for AEC. At least 10 being developed. SNAP I is operational model of SNAP III, miniature atomic generator weighing less than four lb and powered by radioactive isotopes from polonium-210. SNAP I will reportedly power a television-type scanner in Samos reconnaissance satellite. Design and development of overall system is under the Nuclear Div. of The Martin Co. SNAP II is 220 lb Atomics International thermal reactor. SNAP VIII is a reactor which could produce electrical energy for an electrical propulsion system. It would have ten times the power of SNAP II on which it is based.

SNOOPER — Reconnaissance vehicle using ion propulsion. Proposed by North American Aviation.

SOLAR—For experiments at extremely high altitudes. Will eventually use solar energy.

SOLAR SATELLITES — NASA program for gyro-stabilized solar observatory satellites in elliptical orbits around sun. Launch '60. Thor-Able IV vehicle.

SOMNIUM — Highly classified ARPA satellite program.

SPU—Self - propelled, plastic, torpedo - shaped underwater atomic missile which Navy frogmen could straddle and steer toward enemy submarines or shore installations. Robot mechanism takes over once the frogman has hopped off to safety. Aerojet-General.

SR-199—Third generation ICBM being studied by a dozen leading companies. Operational by 1970 in Air Force estimates, it would fire instantaneously by remote control, and could counteract anti-missile missiles.

START—Re-entry test vehicle that would use proven solid rockets and cost only ¼ as much as liquid fueled missile boosters now being used for such work. Basic rocket would be a Thiokol Sergeant engine. Boeing proposal.

STRAT-LAB — Manned balloon flights making telescopic studies at high altitudes. Studies conducted by The Office of Naval Research and Johns Hopkins University.

STUDY REQUIREMENT (SR)—1828192—Air Force and industry studies on use of moon and other plants for strategic bases.

SUBROC—Navy weapon with 25-50 mi range to detect and destroy submarine. Goodyear has $65-million contract.

SUNFLARE—Series of high altitude shots to study solar flares and solar temperatures. Nike and Aerobee rockets used.

SUPER TALOS—Advanced version of Talos missile with anti-missile capability.

SUZANO—ARPA space platform studies which were terminated without official reassignment.

TACKLE — Follow - on to Task Steer. Advanced active polar communications satellites.

continued on next page

A list of advanced weapons and space projects. Futures will be dictated by the budget and military strategy

TASK COURIER — Delayed repeater communications satellites; first phase of intercontinental satellite communications system under Project Notus. Courier, refinement of work initiated with Project Score, will have capacity equivalent to twenty 100-word-per-minute teletype channels throughout the world. Project is still funded and managed by ARPA though slated for transfer to the Army. First Courier shot expected this summer. Development by a team including Philco Corp., Radiation Inc. and I. T. & T.

TASK DECREE — Global communication satellite system with at least four instantaneous repeater satellites in 24 hr orbits over the equator.

TASK STEER—Instantaneous-repeater polar-orbiting communications satellites. Being developed by GE and Bendix Aviation.

TCBM—Transcontinental Ballistic Missile. To reach almost any target on Earth from U. S. Probably will use Atlas or Titan first stage with payload section equipped with aerodynamic surface or wings. Missile would become a hypersonic glide bomber. Range: 11,000 mi.

TEPEE—System for detecting intercontinental missile launchings or nuclear explosions by "back-scatter," bouncing radar signals off ionized trail produced in ionosphere.

THORIC—Intercontinental version of Thor. Under evaluation at Douglas.

TIROS—NASA meteorological satellite containing TV cameras to take pictures of the Earth's cloud cover. Launchings slated to begin this Spring. RCA and the Army Signal Corps are conducting the work.

TRANSIT—Research and development on use of satellites and space vehicles as radio frequency navigation aids. Satellite system is being developed by Lockheed and Johns Hopkins University. Research shot of Transit 1B expected March '60 with Thor booster coupled to new version of Aerojet AJ10-101A Vanguard engine. Program still funded by ARPA though slated for transfer to the Navy.

TRIBE—ARPA program for developing a family of advanced military space vehicles.

VELA — ARPA program for research, experimentation and system development related to the nuclear test moratorium.

WAGMIGHT — Jet-propelled inflatable missile in early research.

WAG TAIL—Air-to-surface missile to be fired from low altitude bombers. Uses solid propellant engine; can be fired over obstacles such as mountains. Air Force-Minneapolis-Honeywell.

WIZARD — Anti-missile missile studied by Convair. Air Force.

WS-117L—Entire Air Force advanced reconnaissance program including Samos, Midas, and Discoverer satellites.

WS121B—Air-launched anti-radar missile being studied by Air Force.

WS-125A—Air Force project to develop a nuclear-powered aircraft. Convair-Fort Worth holds airframe contract. General Electric and Pratt & Whitney are developing powerplants.

X-15 — Rocket-powered research aircraft designed to reach 100,000 ft and 3600 mph. First model, extensively tested by North American Aviation, is slated for delivery this Spring to NASA and the Air Force.

POPULAR NAMES OF U.S. MISSILES & ROCKETS

MISSILES

Name	Designation	Service
Atlas	SM-65	AF
Bomarc	IM-99	AF
Bullpup	ASM-N-7	Navy
	GAM-83	AF
Corporal	SSM-A-17	Army
Corvus	ASM-N-8	Navy
Crossbow	GAM-67	AF
Dart	SSM-A-23	Army
Eagle	XAAM-10	Navy
Falcon	GAR-1, -2	AF
Firebee	Q-2	AF
Hawk	SAM-A-18	Army
Hound Dog	GAM-77	AF
Jupiter	—	Army-AF
Lacrosse	SSM-A-12	Army
Mace	TM-76	AF
Matador	TM-61	AF
Minuteman	SM-80	AF
Nike-Ajax	SAM-A-7	Army
Nike-Hercules	SAM-A-25	Army
Nike-Zeus	—	Army
Pershing	—	Army
Petrel	AUM-N-2	Navy
Polaris	FBM	Navy
Quail	GAM-72	AF
Rangemaster	RP-77	AF
Rascal	GAM-63	AF
Raven	XASM-9	Navy
Redstone	SSM-A-14	Army
Regulus	SSM-N-9	Navy
Samos (Sentry)	WS-117L	AF
Sergeant	SSM-A-27	Army
Sidewinder	AAM-N-7	Navy
	GAR-8	AF
Snark	SM-62	AF
Sparrow	AAM-N-2, -3, -6	Navy
Subroc	—	Navy
Super Falcon	GAR-3	AF
Talos	SAM-n-6	Navy
Tartar	—	Navy
Teal	XKDT-1	AF
Terrier	SAM-N-7	Navy
Thor	SM-75	AF
Titan	SM-68	AF
Wizard	WS-222A	AF

ROCKETS

Name	Designation	Service
Bolt	T-238	Army
Genie	MB-1	AF
Gimlet	ALR	Navy
Honest John	—	Army
Little John	—	Army
Wag Tail	—	AF
Weapon Able	Anti-Sub	Navy
Zuni	—	Navy

Source: Department of Defense.

The Budget— How Much For What

Estimates peg Presidents defense spending at $14.675 billions for aerospace; Congress may boost B-70, and missile funds

The battle lines are drawn. Sniper action began almost as soon as the forces collected in their various camps. Object—the battle of the budget. In this election year, the President was clearly asking for a fight when he presented a budget that called for almost no increase over last year. His assurance that he knew "more about this country's defense than almost anyone" rang hollow in the many ears that are filled with phrases like "missile gap" and "space lag." The main objection to the budget estimate seems to be that it does not adequately meet the challenge of a 3 to 1 Russian ICBM superiority in 1962. But, unless Congress changes the President's estimate, new spending for national security will stand at $40.9 billion. It is difficult to get a dollar-by-dollar account of the fiscal 1961 budget funds, but the aerospace industries figure to get about $14.7 billion. (Coupled with $2 billion in commercial aviation and nearly as much in general aviation, the market potential for this coming fiscal year is a whopping $18 billion in new spending.)

Estimated breakdown on the spending is as follows: Direct procurement of aircraft $4.753 billion; procurement of missiles $3.825 billion; research development test and evaluation of aircraft $446.2 million, missiles $1481.6 million, astronautics $318 million; missile base construction $600 million; ARPA $215 million; NASA $915 million; AEC $125 million for aircraft and rocket reactors; AEC $495 million for weapons; FAA $383 million.

What The Dollars Will Buy—About 1510 aircraft will be purchased by the military, a decline of about 100 units over last year. Navy will buy the largest number, 658; Air Force 633; Army 219. North American's A3J, McDonnell's F4H, and Chance Vought's F8U-2N are all high on Navy's list of high performance aircraft. Grumman's A2F and S2F will get a large share of Navy spending for slower, lower missions.

Air Force will buy 220 F-105's, the only fighter it is giving new funds. The heavier aircraft to be procured by Air Force are: B-52H, B-58, KC-135, and C-130. About 300 new B-52's and 90 new B-58's will remain a major part of AF deterrent in the next 3 years. A considerable number of helicopters and jet trainers will also be purchased. Funds are provided to bring the MATS air-lift capability up to jet standards. The B-70 could loom back into the picture considering there is a $4.2 billion surplus program for the overall budget. Some of this money could conceivably be directed into increasing B-70 work beyond airframe and power plant.

Army aircraft procurement will rise about 35 per cent. The STOL variety of aircraft will enjoy a predominance. Mohawk, Caribou, and Iroquois will get most of the fixed-wing money. First production models of Vertol's new Chinook will bolster Army's helicopter forces late in the year.

Four strategic missiles will be produced with new funds, but not necessarily delivered this year—Atlas (13 squadrons of 10 each), Titan (14 squadrons of 10 each), Minuteman and Polaris (3 new submarines with 16 missiles on each). Pershing

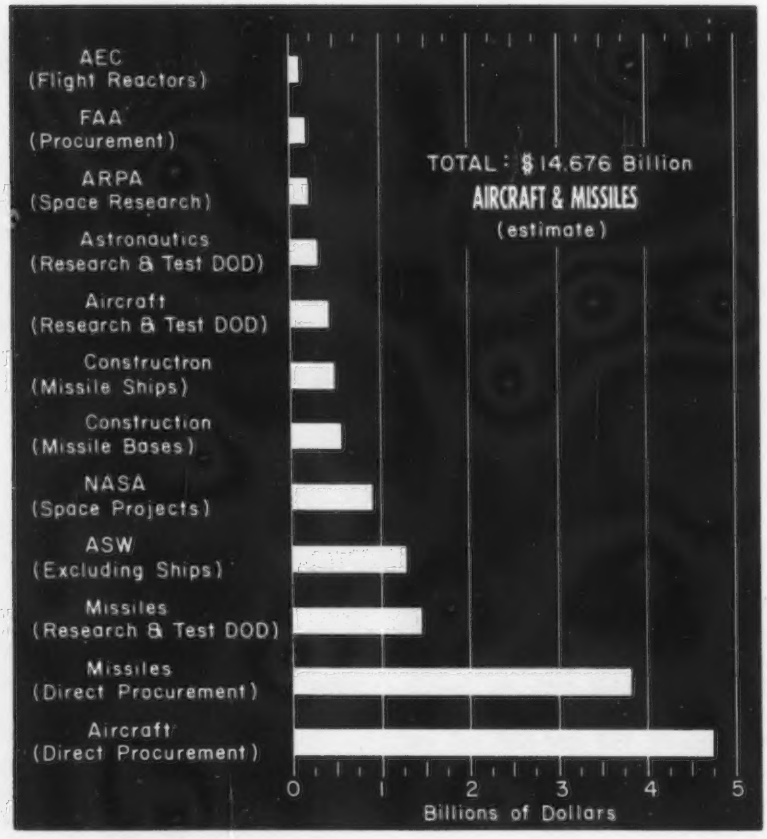
No new money going to Thor or Jupiter; Research, development, money at all time high; Procurement of aircraft still top expenditure

will continue on a high priority basis but will not hit production status before the end of the year. About $118 million was allocated to Pershing in fiscal 1960 and this should be increased slightly in 1961. No new money goes into either Thor or Jupiter. Nike-Hercules and Bomarc production will be almost completed during the year. This means that ground launched bomber defense missiles are just about phased out. Nike-Zeus is not scheduled for production, but has $300 million funding. It could receive sudden go-ahead, or be dropped.

The air launched Hound Dog, Quail, and Falcon will continue at high production level in the Air Force budget. Sky Bolt ($60 million) will not come into production status.

Procurement of Navy's Bullpup, Talos, Terrier, Tartar, Sidewinder, Sparrow and Zuni will continue at high volume. Navy is also exploring several anti-submarine weapons which are air-to-underwater vehicles.

Army will concentrate its buying in Sergeant, LaCrosse, Hawk, and the John series. Sizable quantities of small field weapons like Red Eye and Davy Crockett will also be procured.



THE PRESIDENT'S BUDGET shows that procurement of aircraft is still top expenditure. Graph shows only new obligations for fiscal 1961. Spending could hit $6 billion with back orders for aircraft.

Research Money—Aside from those vehicles already mentioned for research funding, X-15 and Dynasoar will come in for a large amount of the military spending.

A system of satellite communications and reconnaissance vehicles will also receive military funding. Responsibility for Midas, Samos, Notus, and Transit were recently transferred from ARPA to the military, and the military will absorb all the funding in the coming fiscal year. The large rocket system called Saturn is being funded by NASA.

Still ignored despite growing evidence that a continuously airborne alert could be essential, is the nuclear aircraft. Only $73 million in new funds goes to developing a reactor for this vehicle.

Space Spending—Early in February, President Eisenhower sought to meet mounting criticism of the space budget by giving NASA $113 million more than his original estimate. This brought the total NASA budget to $915 million. A good deal of the money in the NASA budget ($230 million) will go into the Saturn project. Further acceleration of our space efforts, sometime during the year, is almost assured as a result of Congressional initiated criticism. This will happen despite the fact that this year's allocated spending is almost 45 per cent above last year's total outlay.

If all goes well with the Mercury project, it should enter the operational phase in fiscal 1961. Manned flights are expected to be attempted before the end of the calender year. Final bidding on Project Centaur took place early in February and results have not yet been announced. It is expected that Project Centaur, however, will be ready for testing during this fiscal year. Some of the important space vehicles that will be worked on during 1961 are listed in the various sections of the Missile Handbook in this issue.

◆

Contractors Directory

This listing was compiled and printed on Univac I data processing and high-speed printout equipment at University of Pennsylvania Computing Center. Intent was to furnish for future reader service the multiplicity of cross references that can be obtained on this equipment. The editors express regret that in some instances the original printout was not of the quality necessary for satisfactory reproduction.

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
		A					
ACF INDUSTRIES INCORPORATED 750 THIRD AVENUE NEW YORK 17, N.Y. YU6-8600	MERCURY	AVION DIVISION 11 PARK PLACE PARAMUS, N.J. CO1-4100	F	TRANSPONDERS	J. DRVINCETEN	W. BINGHAM	W. GUY
	ATLAS TITAN DISCOVERER CORVUS DELTA			RADAR BEACONS SAME SAME SAME SAME	SAME SAME SAME SAME SAME	SAME SAME SAME SAME SAME	SAME SAME SAME SAME SAME
	ATLAS	NUCLEAR PRODS.-ERCO DIV. RIVERDALE, MD. WA7-4444		GUIDANCE CHECKOUT DATA FLOW			
	TALOS	SAME		WARHEAD COMPONENTS			
	TARTAR	SAME		SAME			
	HOVER	NUCLEAR PRODUCTS-ERCO DIV ALBUQUERQUE, N.M. CH7-0361		PROPULSION COMPONENTS			
	GOOSE	AMERICAN CAR&FOUNDRY DIV. BERWICK, PENNA. PL 253611		PROPULSION CASES, NOZZLES			
	SUBROC	SAME		PROP TEST CASES			
	POLARIS	SAME AND MILTON, PENNA.		1ST & 2ND STAGE PROP CHAMBERS			
	SNARK	SAME BERWICK, PENNA.		LAUNCHERS			
	TERRIER RASCAL GREEN QUAIL	SAME SAME AVION DIV. PARAMUS, N. J. OL 1-4100		FIRE CONTROL GROUND HANDLING DETECTION			
	JUPITER REDSTONE JUPITER	SAME SAME ADVANCED PRODS. DIV. ST. CHARLES, MD. RA 4-2980		TEST EQUIPMENT COMPONENTS SPEC ASSEMBLY EQUIPMENT			
	POLARIS THOR TITAN JUPITER ATLAS SNARK TELEPC MINUTEMA	SAME SAME SAME NUCLEAR PROD.-ERCO SAME SAME		ROCKET THRUST CHAMBER ENGINE THRUST MOUNTS PRESSURE VESSEL HEADS-STORAGE SUB-STRUCTURE MAINT. TRAINING EQUIPMENT SUB-ASSY DEVEL. & LAUNCHERS R & D			
			E	RAIL, LAUNCH SYSTEMS			
AER. INC. 871 E. WASHINGTON BLVD. PASADENA, CALIFORNIA SY 4-9725		"	H	TRACKING DEVICES	R. OLIVER	R. OLIVER	R. OLIVER
		"	B	BRAKING DEVICES	R. OLIVER	R. OLIVER	R. OLIVER
ACE ELECTRONICS ASSOCIATES, INC. 99 DOVER STREET SOMERVILLE, MASS. SO 6-5170		ACE ELECTRON. ASSOC. 99 DOVER STREET SOMERVILLE, MASS. SO 6-5170	E	PRECISION POTENTIOMETERS	L. BERNI	J. MASTROMARINO	A. SOLOMON
ACROMAG, INCORPORATED 22519 TELEGRAPH ROAD SOUTHFIELD, MICH. EL 6-7211	TITAN	"		PRECISION MAGNETIC AMPLIFIERS	H. PATTON	K. SUMSTAD	R. HENNINGS
	ATLAS	"		SAME	SAME	SAME	SAME
ADAMS RITE MFG. CO. 540 W. CHEVY CHASE GLENDALE, CALIF. CI 1-5121	TITAN			HANDLES, LOCKS, LATCHES	D. GRIZZARD	D. WOLPERT	
	ATLAS VEGA			SAME SAME	SAME SAME	SAME SAME	
ADVANCED ELECTRONICS, INC. 96 SILAS DEANE HIGHWAY ROCKY HILL, CONN. JA 9-6881	SNARK	ADVANCED ELECTRONICS, INC. 96 SILAS DEANE HWY. ROCKY HILL, CONN. JA 9-6881	A	SUPPORTING TOOLING AND FIXTURES	S. FRIEDMAN	A. DINUNZIO	F. LUCK
	HOUND DOG			SAME	SAME	SAME	SAME
ADV. TECH. LAB., DIV. 369 WHISMAN ROAD MOUNTAIN VIEW, CALIF. YO 8-8461	DISCOVERER	"	E	GUIDANCE	W. SNYDER	J. MCENROE	J. CURTIN
	DISCOVERER MINUTEMA	"	H C	TEMPERATURE SENSING EQUIPMENT CHECKOUT EQUIPMENT	F. WEMUTH V. ADAMS	SAME SAME	SAME SAME
ACOUSTICA ASSOCIATES, INC. 26 WINDSOR AVE. MINEOLA, L.I., N.Y. PI 7-7900	POLARIS JUPITER VANGUARD NEW HORIZONS ATLAS	"		LIQUID LEVEL CONTROLS & SYSTEMS SAME SAME SAME FUEL MANAGEMENT			
			B	SOUND CONTROLLED ROCKET ENGINE PROPELLANT UTILIZATION SYSTEM			
AEROJET-GENERAL CORP. 6352 N. IRWINDALE AVE. AZUSA, CALIF. CU3-6111	AN/USD-2	11711 WOODRUFF AVE.	F	DRONES, LAUNCHERS, ENGINES GUIDANCE & RECOVERY WARHEAD	J. JOERGER	F. NANCE	C. PEURRUNG
	NIKE-HERCULES	SOLID ROCKET PLANT P.O. BOX 1168 DOWNEY, CALIF. SP 3-0130 SACRAMENTO, CALIF. EM3-3111					
	GRELLPUP POLARIS SPARROW III TARTAR TERRIER ORION MIGHTY MOUSE MINUTEMAN SNARK AEROBEE	SAME SAME SAME SAME SAME SAME SAME SAME SAME LIQUID ROCKET PLANT P.O. BOX 1947 SACRAMENTO, CALIF.		ROCKET MOTOR POWERPLANT SAME SAME SAME SAME METAL PARTS & ROCKET MTR. 2ND STAGE PROPULSION POWERPLANT POWERPLANT			
	GONARC TITAN EX-8	SAME SAME SOLID ROCKET PLANT P.O. BOX 1168 SACRAMENTO, CALIF. EM3-3111		BOOSTER ROCKET & WARHEAD POWERPLANT, AUX. PWR. DEVELOPMENT			

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
AEROJET-GENERAL CORP. AZUSA, CALIF.	SPU	SACRAMENTO, CALIF.		R & D			
	JYNA-SOAK	SAME		BOOST ROCKET SYSTEM			
	MINUTEMAN	SAME		2ND STAGE MOTORS			
	JYNA-SOAK	ARCHITECTUNAL & ENGR. COVENA, CALIF. ED4-6211		DESIGN-LAUNCHING PROPULSION			
	THOR/ABLE	LIQUID ROCKET PLANT P.O. BOX 1947 SACRAMENTO, CALIF.		PROPULSION SYSTEM & TANKS			
	JYNA-SOAK	SOLID ROCKET PLANT		ROCKET BOOSTER			
	EAGLE	SAME		POWERPLANT			
	FIREBEE	SAME		SAME			
	HAWK	SAME		SAME			
	HOVER	SAME		REACTOR			
	SPARK	SAME		POWERPLANT			
	LA CROSSE	LIQUID ROCKET PLANT		STORABLE LIQUID PROPULSION			
	APACHE	SAME		SAME			
	APROBEE	SYSTEMS DIV.		PRIME CONTRACTOR			
	ASTROBEE	SAME		DEVELOPMENT			
	APROPAK	SAME		FEASIBILITY STUDY			
	MINUTEMAN	SAME		TEST SLED PROPULSION			
	MARK 46	"		DEVELOPMENT			
	SCOUT			SHIPPING & TESTING OF 1ST STAGE			
	DELTA	LIQUID ROCKET PLANT		2ND STAGE POWERPLANT			
	LOSHUS			DEVELOPMENT			
	ATLAS	LIQUID ROCKET PLANT		POWERPLANT			
	ABLE-STAR	SAME		SAME			
	SKY BOLT	SOLID ROCKET PLANT		PROPULSION SYSTEM			
	NIKE	DEFENSES & TECH. PROD. 11711 BOOMUFF Ave. DOWNEY, CALIF.		WARHEAD & FUZE			
	SPARROW	SAME		SAME			
	ATLAS	SAME		PRESSURE VESSEL			
	FIRETRAC	ATLANTIC DIVISION P.O. BOX 460 FREDERICK, MD. MO 2-4181	C	NUCLEAR REACTORS	K. JOHNSON	K. NEWACHECK	M. LOWLER
				DISTANCE MEASURING EQUIP.	E. KOLSAAS	J. MCNEAL	F. HEIMANN
		NUCLEONICS DIV. P.O. BOX 77 SAN RAMON, CAL. VE 7-5311		RADIOGRAPHIC INSPECTION UNITS	P. UNDERHILL	SAME	SAME
AEROJET MANUFACTURING CORP. 1734 GERMANTOWN ROAD MIDDLETOWN, OHIO GA 2-2751	HAWK	"	D	AIRTRANSPORTABLE SHELTERS	E. SWANSON	L. RATCHE	R. PAUL
	JUPITER	"	C	SHELTER	SAME	SAME	SAME
	POSEIDON	"	C	TARGET MISSILE	SAME	SAME	SAME
	JOMARC	AEROCAL DIVISION 24751 CRENSHAW BLVD. TORRANCE, CALIF. DA 6-8820		ELECTRONIC CHASSIS ASSEMBLY	D. CHAPMAN	A. STRUNK	A. MILLARD
AEROTEC INDUSTRIES, INC. GREENWICH, CONN. JE 1-8400	JOMARC	"		PITOT TUBES, DISCONNECTS			
	LACROSSE	"		PITOT TUBES, DISCONNECTS			
	FIREBEE	"		PRESSURE SWITCH			
AIR ACCESSORIES, INC. 1400 HENDERSON STREET FORT WORTH, TEXAS ED 5-3214		"	B	SPECIAL SANDWICH PANELS	C. SKINNER	E. SMITH	F. SMITHFIELD
		"	C	THERMOPLASTIC PRODUCTS	SAME	SAME	SAME
AIRATERIA 620 PAULA AVENUE GLENDALE 1, CALIF. CH 5-8321	ATLAS	"	H	DISCONNECT COUPLINGS	P. EVANS	B. JAMESIAN	L. HARRIS
	MACE	"	C	DUCT ASSEMBLIES	SAME	SAME	SAME
	HOUND DOG	"	C	CONNECTORS, COUPLINGS	SAME	SAME	SAME
AIRCON, INC. 48 CUMMINGTON BOSTON, MASS.	COURIER	"	A	DIPLEXERS	R. RIVERS	E. MANERA	F. STACA
	HAWK	"	A	HORNS ADAPTERS		SAME	SAME
AIRCRAFT ARMAMENTS, INC. COCKEYSVILLE, MD. NO 6-1400	ATLAS	"		TRAINING SYSTEMS AND SIMULATORS	R. APPLE	H. KNIESCHE	R. SPARTZ
	MINUTEMAN	"		SAME	SAME	SAME	SAME
	POLARIS	"		SAME	SAME	SAME	SAME
	PERSHING	"		SAME	SAME	SAME	SAME
	TITAN	"		SAME	SAME	SAME	SAME
	SPARROW	"	E	SAME	SAME	SAME	SAME
	TARTER	"		CHECK-OUT AND TEST EQUIPMENT	SAME	SAME	SAME
	TALOS	"		SAME	SAME	SAME	SAME
	TITAN	"		SAME	SAME	SAME	SAME
	POLARIS	"		SAME	SAME	SAME	SAME
	MINUTEMAN	"		SAME	SAME	SAME	SAME
	JUPITER	"		WARHEADS	SAME	SAME	SAME
	CORPORAL	"		SAME	SAME	SAME	SAME
	NAVAJO	"		SAME	SAME	SAME	SAME
	JOMARC	"		SAME	SAME	SAME	SAME
	NIKE	"	D	SAME	SAME	SAME	SAME
	NIKE	"		ROCKET TEST SLEDS	SAME	SAME	SAME
	NAVAJO	"		SAME	SAME	SAME	SAME
	POLARIS	"	C	SAME	SAME	SAME	SAME
THE AIRCRAFT FITTING COMPANY 701 NORTH FEDERAL HIGHWAY DANIA, FLORIDA WA 3-2391		"		HYDRAULIC TUBE FITTINGS	R. PETERSON	J. ANGELOW	P. HIMMEL
AIRDOX LABOR PROD. CO. 307 NORTH MICHIGAN AVE. CHICAGO 1, ILLINOIS FA 6-5393	ATLAS	MABEE, ILLINOIS LO 3-2891	D	MOBILE HELIUM COMPRESSORS	G. JUERGENSEN	J. SWANSON	R. BAILLY
AIRCO, INC. 2323 SECOND AVE. SCHENECTADY 3, N.Y. EL 5-6545		"	C	ENVIRONMENTAL TEST EQUIPMENT	H. IRVINE	SAME	SAME
AIRITE PRODUCTS, INC. 3510 E. OLYMPIC BLVD. LOS ANGELES 23, CALIF. AN 8-4137	ATLAS	"	D	TITANIUM PRESSURE VESSELS	D. ESTES	A. LOYA	J. REINHOLDT
	ATLAS	"	A	DUCTING	SAME	SAME	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000 C—$100,000—$500,000 E—$1 —$10 million G—$25—$50 million I—$75 —$100 million K—Over $250 million
B—$50,000—$100,000 D—$500,000—$1 million F—$10—$25 million H—$50—$75 million J—$100—$250 million

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
AIRLINE WELDING & ENG. 15899 So. SAN PEDRO GARDENA, CALIF. FA 1-2700	POLARIS	"	B	TOOLING	OERTEL	FORNEY	BUXTON
		"					
		"					
	ATLAS	"	A	TUBING	SAME	SAME	SAME
AIR LOGISTICS CORP. 3600 E. FOOTHILL BLVD. PASADENA, CALIF. SY 6-7191	ATLAS	"		GROUND SUPPORT EQUIP.	M. HARPER	J. ADAMS	C. WILSON
	THOR	"			SAME	SAME	SAME
	TITAN	"			SAME	SAME	SAME
	GAM 72	"			SAME	SAME	SAME
	GAM 77	"			SAME	SAME	SAME
	GAR 9	"	E		SAME	SAME	SAME
AIROYAL MFG. COMPANY 1990 SPRINGFIELD AVENUE MAPLEWOOD, NEW JERSEY SO 2-1700	GOMARC		B	LAUNCHERS	J. PLEASANTS	H. DRAKE, JR.	E. WOLTERS
AIR PRODUCTS, INC. P. O. BOX 538 ALLENTOWN, PENNA. EX 5-3311		"	C	OXYGEN-NITROGEN GENERATOR	D. SMITH		
		"	C	MOBILE LOX GENERATORS	D. SMITH		
		"	F	SKID-MOUNTED O2-N2 GENERATORS	D. SMITH		
		"	C	LIQUID FLUORINE	R. VANDYKE		
		"	A	ANALYZER	B. VANDYKE		
		"	C	NITROGEN TRIFLUORIDE	R. VANDYKE		
		"	C	LIQUID HYDROGEN SEMI-TRAILERS	D. SMITH		
		"		LIQUID OXYGEN, LIQUID HYDROGEN	B. WORKER		
AIRTEK DYNAMICS, INC. 18201 S. SANTA FE AVE. COMPTON, CALIF. NE 6-8741		"	F	COMPONENTS	J. TOLAND	P. EYRAUD	R. PETERS
ALAD ALUMINUM LADDER CORP. 7260 MELROSE AVE. LOS ANGELES 46, CALIF. WE 4-5000		1448 SIGNAL DRIVE POMONA, CALIF. NA 2-2478	C	ALUM. LADDERS & STANDS, PORTABLE STAIRS	G. HUGHES	B. HAMBLY	R. HAMBLY
ALCO PRODUCTS, INC. 320 SOUTH ROBERTS ROAD DUNKIRK, NEW YORK EM 6-6000	HONEST JOHN	THERMAL PROD. DIV.	E		C. MILLER		
	PERSHING	SAME	C	ROCKET MOTOR CASES	SAME		
ALLEGHENY BALLASTICS LAB. CUMBERLAND, MARYLAND RE8-9000	LITTLE JOHN	"		POWERPLANT			
	TALOS L	"		SAME			
	TALOS	"		SAME			
	TARTAR	"		SAME			
	TERRAPIN	"		SAME			
	TERRIER	"		SAME			
	VANGUARD			3RD STAGE ENGINE			
	POLARIS			2ND STAGE ENGINE			
	THOR/ABLE			3RD STAGE ENGINE			
	GRILLPUP			SOLID PROP. MOTOR			
	SCOUT			PROCUREMENT OF ALL ENGINES & A & D HIGH ENERGY SOLID PROP			
R. C. ALLEN BUSINESS MACH., INC. 678 FRONT AVE., N.W. GRAND RAPIDS, MICH.		AIRCRAFT INST. DIV. 333 COMMERCE AVE., S.W. GRAND RAPIDS, MICH. GL 6-8541		RATE OF TURN INDICATORS	R. JOHNSTON	V. FRIELINK	V. FRIELINK
ALLIED CHEMICAL CORPORATION 40 RECTOR STREET NEW YORK 6, N.Y. HA 2-7300		GENERAL CHEM DIV. P. O. BOX 405 MORRISTOWN, N.J. JE 8-8000	D	SOLID PROPELANT OXIDIZERS	H. NEUMARK		
ALLIED RESEARCH ASSOC., INC. 43 LEON STREET BOSTON 15, MASS. GA 7-2434	ITROS	"	C	DATA INTERPRETATION SYSTEM	A. GLASER		MCGUIRE
	HARDTACK PH 1	"	D	INSTRUMENT POD	A. ATKINSON		MCGUIRE
	HARDTACK PH 2	"	B	INSTRUMENTATION	E. GRAY		MCGUIRE
	ALIPAP	"	C		R. SUMNERS		MCGUIRE
	WIND SONDE	"	D	METEOROLOGICAL INSTRUMENTATION	L. ROSSBACH		MCGUIRE
ALLOY BELLOWS, INC. 18125 RUSELAND ROAD CLEVELAND 24, OHIO IV 6-3990		"	A	PRESSURE SWITCH	R. PETTERSSON	R. DANIELSON	R. PETTERSSON
ALLOY STEEL CASTING CO. COUNTY LINE ROAD SOUTHAMPTON, PA. EL 7-1545	ATLAS	"		VALVES, PUMPS & COMPONENTS	D. VOLK	J. CUNNINGHAM	J. HOTHROCK
		"					
	GOMARC	"		SAME	SAME	SAME	SAME
	POLARIS	"		SAME	SAME	SAME	SAME
	TITAN	"	E	SAME	SAME	SAME	SAME
ALL-TRONICS, INC. 45 BOND STREET WESTBURY, NEW YORK GD 3-3090		"		RADIO INTERFERENCE FILTERS	H. ARSTEAN		T. SILVIA
ALTO SCIENTIFIC CO., INC. 855 COMMERCIAL STREET PALO ALTO, CALIF. DA 1-3494	CENTAUR	"	A	GROUND SUPPORT EQUIPMENT - ELECTRONICS	K. MCQUEENEY	J. MELTON	V. BARRETT
	MINUTEMAN	"		SAME	SAME	SAME	SAME
	DISCOVERER	"		SAME	SAME	SAME	SAME
	MIDAS	"		SAME	SAME	SAME	SAME
	SAMOS	"	C	SAME	SAME	SAME	SAME
AMCEL PROPULSION INC. 180 MADISON AVENUE NEW YORK 16, NEW YORK MU 9-6000		P.O. BOX 3049 ASHEVILLE, N.C. AL 3-6464	C	INCENDIARIES	L. FOX	F. SMITHERD	H. KITSELMAN

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)		$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
AMERICAN AIR FILTER CO., INC. 215 CENTRAL AVENUE LOUISVILLE, KENTUCKY	HAWK	DEFENSE PROD. DIV. 310 THIRD STREET ROCK ISLAND, ILL.			ENVIRONMENTAL SUPPORT EQUIPMENT	H. KIRK	E. DEMUYNCK	M. MARLAIRF
	LITTLE JOHN	"			ENVIRONMENTAL SUPPORT EQUIPMENT	W. MILLMAN	SAME	SAME
	ATLAS	"			ENVIRONMENTAL SUPPORT EQUIPMENT	H. KIRK	SAME	SAME
	E.R.S.	"			ENVIRONMENTAL SUPPORT EQUIPMENT	H. LATHROP	SAME	SAME
AMERICAN BOSCH ARMA CORP. 320 FULTON AVENUE HEMPSTEAD, NEW YORK PI 2-2000	ATLAS ICBM	ARMA DIVISION ROOSEVELT FLD. GARDEN CITY, N.Y.			INERTIAL GUIDANCE SYSTEM	A. SOMMER	W. ALEXANDER	G. RYAN
AMERICAN BRAKE SHOE CO. 530 FIFTH AVENUE NEW YORK 36, NEW YORK OX 7-7000		KELLOGG DIVISION 99 HUMBOLDT ST. ROCHESTER 9, N.Y.	BU 8-2020	F	HYDRAULIC PUMPS MOTRS & CONTROLS	G. PESCE	H. KISTLER	F. COGSWELL
AMERICAN ELECTRONICS, INC. 1025 W. 7TH STREET LOS ANGELES, CALIF. MA 4-9241	TARTAR	INSTRUMENT DIV. 9903 JEFFERSON CULVER CITY, CALIF.	VE 8-6402	D	RESOLVERS	R. KOLKAL	P. MODELESKI	W. HEALY
	HOUND DOG			C	QUADRATURE REJECTOR	J. BURWELL	R. BECTAL	W. HEALEY
	POLARIS			B	RESOLVERS	L. WILSON	D. DUTTON	W. HEALEY
AMERICAN MACHINE & FOUNDRY CO. 261 MADISON AVENUE NEW YORK 16, N.Y. MU 7-3100	PROJ. MERCURY	MECH. RES. DIV. 7901 NATCHEZ AVE. NILES, ILL.	NI 7-7000		RELIEF FACILITIES	E. JOHNSON	H. REX	R. VANEVERA
	GREEN QUAIL	SAME			SHACKLE EJECT. JETTISON CYL.	R. BARBENEK	SAME	SAME
	AERO. REAP.	SAME			GROUND SHELTER SYSTEMS	T. MORRISON	SAME	SAME
	TITAN	GEN. ENG. LAB. GREENWICH, CONN.	NO 1-7400	I	GROUND SUPPORT & TRAINING	G. CROSBY	H. OLES	S. BRADLEY
					LAUNCHING	W. GRAESMANN	D. SMITH	S. BRADLEY
	ATLAS	SAME		E	HARD BASE ANT.	W. STUMPE	H. SCUDDER	S. BRADLEY
	TITAN	SAME		E	TRACKING	C. HOELY	SAME	SAME
	PIM	STAMFORD, CONN.	FI 8-5851	E	SAME	SAME	SAME	SAME
	TIM	SAME			SAME	SAME	SAME	SAME
	SCR-270	SAME		C	RADAR	SAME	SAME	SAME
AMERICAN MISSILE PROD. CO., INC. 15233 GREVILLEA AVENUE LAWNDALE, CALIF. OS 9-1404	SERGEANT	"		E	TELEMETRY EQUIPMENT	W. JAMEWAY	J. GREENWELL	S. JORDAN
	VEGA	"		B	SAME	SAME	SAME	SAME
AMERICAN RESEARCH AND MFG. CORP. 920 HALPINE AVENUE ROCKVILLE, MD. HA 7-7117	SUBROCK	"		A	ENGR. SERVICES INSTRUMENTS	J. WESCOTT	J. FOGELGREN	R. TAYLOR
	POLARIS	"		A	CONTROL EQUIPMENT	SAME	SAME	SAME
	HAWK	"		A		SAME	SAME	SAME
	MACE	"		B		SAME	SAME	SAME
THE AMERICAN BRASS COMPANY 498 SOUTH MAIN STREET WATERBURY 20, CONN. PL 4-1171	JUPITER	"			FLEXIBLE HOSE	H. MCCADE	C. WEBBE	W. EDWARDS
	REDSTONE	"			SAME	SAME	SAME	SAME
	THOR	"			SAME	SAME	SAME	SAME
	CORPORAL	"			SAME	SAME	SAME	SAME
	SONARC	"			SAME	SAME	SAME	SAME
	TITAN	"			SAME	SAME	SAME	SAME
	SONARC	"			FLEXIBLE METAL WIRING CONDUIT	SAME	SAME	SAME
AMERICAN POTASH & CHEMICAL CO. LOS ANGELES, CALIF. BU 2-8231	SPARROW III	NAT. NORTHERN DIV.		C	FUZE	E. KENT	K. GIBBONS	T. WRIGLEY
	POLARIS	SAME		C	BELLOWS, MOTORS	SAME	SAME	SAME
	MINUTEMAN	SAME		C	BORON PELLET	SAME	SAME	SAME
		HENDERSON PLANT		E	HIGH ENERGY FUEL	H. CURTIS	F. GOLDSMITH	CORNELIUS
		HENDERSON, NEV.		F	SOLID PROPELLANT OXIDIZERS	SAME	SAME	SAME
THE AMERICAN WELDING AND MFG. CO. 552 DIETZ ROAD WARREN, OHIO EX 3-2531	ATLAS	"			FLASH BUTT WELDED RINGS			
	SONARC	"			SAME			
	GREEN QUAIL	"			SAME			
	MACE	"			NOZZLE ASSEMBLY			
	MERCURY	"			FLASH BUTT WELDED RINGS			
	NIKE	"			SAME			
	PERSHING	"			MACHINING			
	POLARIS	"			ASSY & FLASH BUTT WELDED RINGS			
	TALOS	"			WELDED RINGS & MACHINING			
	SATURN	"			SAME			
AMPHENOL-BORG ELECTRONICS CORP. 1830 S. 54TH AVE. CHICAGO 50, ILL. 812-1000	ATLAS	WEST COAST DIV. 5356 W. PICO BLVD. LOS ANGELES, CALIF.			COMPUTER PACKAGES INTERNAL CONNECTORS			
	TITAN	SAME			CONNECTORS			
	THOR	SAME			SAME			
ANADEX INSTRUMENTS, INC. 14734 ARMINTA STREET VAN NUYS, CALIFORNIA ST 0-7911	JUPITER	"		A	FREQUENCY CONVERTERS	A. WINTER		
ANADITE INC. 10630 SESSLER STREET SOUTH GATE, CALIFORNIA SP 3-6210	POLARIS	"			MISSILE	L. BROOKS	C. KISH	C. EDWARDS
	SONARC	"			SAME	SAME	SAME	SAME
	FALCON	"			LAUNCHERS	SAME	SAME	SAME
	ATLAS	"			MISSILE CLASSIFIED	SAME	SAME	SAME
	TITAN	"			SAME	SAME	SAME	SAME
ANDERSON LABORATORIES INC. 501 NEW PARA AVENUE WEST HARTFORD, CONN. AD 3-649	NIKE	"		A		W. ANDERSEN	H. ANDERSEN	O. CHASE
	SONARC	"		C		SAME	SAME	SAME
	SPARROW III	"		A		SAME	SAME	SAME
	HAWK	"		A		SAME	SAME	SAME
	TITAN	"		A		SAME	SAME	SAME
	ATLAS	"		A		SAME	SAME	SAME
APPLIED MAGNETICS CORP. SANTA BARBARA AIRPORT, GLEN 304 GOLETA, CALIFORNIA 80 7-2016	SERGEANT	"		A	GUIDANCE	H.R. FRANK	B. LAKE	
	AN-107	"			MAGNETIC RECORDERS	H.O. FERGUSON		

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million		
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million			

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
APPLIED RADIATION CORPORATION 2404 NORTH MAIN STREET WALNUT CREEK, CALIFORNIA YE 5-2250	ION PROPULSION	#	B	ION PROPULSION ENGINE COMP	V. SALEMME	R. MARKER	H. LAYSON
				DUST PARTICLE ACCELERATION	SAME	W. EIKEL	SAME
				RADIATION EFFECTS STUDY FACIL	A. KLEIN	R. MARKER	SAME
	POLARIS	#			S. WENK	W. EIKEL	SAME
	MINUTEMAN	#	C	RADIOGRAPHIC LINEAR ACCEL	SAME	SAME	SAME
ARMSTRONG CORK COMPANY LIBERTY STREET LANCASTER, PENNA.	NIKE-ZEUS	# # #	E	POLYSTYRENE CURES FOR RADOME		F. HITTS	
ARONSON MACHINE COMPANY 1001 WEST MAIN STREET ARCADE, NEW YORK 276 & 277		# # #	C	MATERIAL HANDLING	C. ARONSON	F. FULKERSON	C. DEMPSEY
ARVOOD CORPORATION 321 WEST 44TH STREET NEW YORK 36, NEW YORK JU 2-4210		# # #		STEEL PARTS	H. PRESENT	J. SMIEL	
ASSOCIATED CO.'s INC. 1441 S. MCLEAN BLVD. WICHITA 13, KANSAS HO 4-6379	dOMARC	# # #	B	GUIDANCE	J. JANSON	R. TAYLOR	E. LONG
	MINUTEMAN	#	B	CONTAINER	R. MOORE	E. HALL	E. LONG
	MISSILE	#	C	GROUND SUPPORT	J. JANSON	E. TAYLOR	E. LONG
ASSOCIATED AMERICAN WINDING MCH. 750 ST. ANN'S AVENUE NEW YORK 56, NEW YORK CY 2-5050	METEOR	# # #	A	COIL WINDING MACHINERY	W. FORSTER	H. MEIER	G. FRANKLIN
ASSOCIATED TESTING LAB.'s INC. 142 CLINTON ROAD CALDWELL, NEW JERSEY CA 6-7407	PERSHING	FLORIDA DIV. ORLANDO, FLA.		TESTING	J. KORMAN		
	dULLPUP	ENVIRONMENTAL TESTING MFG. DIV.		ENVIRONMENTAL TEST EQUIPMENT	A. ERDMAN	J. STRYKER	C. GHERRIERE
	POLARIS			TESTING			
	TITAN			SAME	SAME		SAME
	ATLAS			SAME	SAME		SAME
				SAME	SAME		SAME
ATLANTIC RESEARCH CORP. SHIRLEY HIGHWAY AT EDSALL RD. ALEXANDRIA, VIRGINIA FL 8-3400	ARCAS	# # #	D	METEOROLOGICAL SOUNDING ROCKET	W. ROBERTS	R. WEBSTER	P. REILLY, JR.
	ARCON	#	C	SOLID PROPELLANT MOTOR/LAUNCHER	R. VANDEVREDE	P. SHANE	SAME
	ATLAS	#		CONTROL ROCKETS	W. ROBERTS	SAME	SAME
	AUTOMET	#		ROCKET SUSTAINER MOTOR	R. VANDEVREDE		SAME
	DELTA	#	B	CONTROL ROCKETS	J. ROSSEN	SAME	SAME
	EXPLORER VI	#	A	CONTROL ROCKET	N. JASPER	SAME	SAME
	IRIS	#	C	HIGH ALTITUDE SOUNDING ROCKET	R. VANDEVREDE	SAME	SAME
	MERCURY	#		CONTROL ROCKETS	J. ROSSEN	SAME	SAME
	MINUTEMAN	#		IGNITER & CLUSTER OF 4 ROCKETS	W. ROBERTS	W. ROBERTS	SAME
	POLARIS	#		MOTORS	E. OLCOTT		SAME
	RED EYE	#		MATERIALS EVALUATION	W. ROBERTS	W. CHARLES	SAME
	SCOUT	#	B	ROCKET MOTOR DEVELOPMENT	J. ROSSEN	J. ROSSEN	SAME
	TIROS	ATLANTIC RESEARCH 19701 W. GOODVALE RD. SAUGUS, CALIF. NE 1-100	B	CONTROL ROCKETS	E. ELZUFON	E. ELZUFON	D. DURHAM
	TERRIER SUST	#	D	IMPROVED PROPELLANT	R. VANDEVREDE	P. SHANE	SAME
	THOR	#	C	CONTROL ROCKET	J. ROSSEN	J. ROSSEN	SAME
ATLAS ENGINEERING CO. INC. 176 BLUE HILL AVENUE ROXBURY, MASS. HI 5-7100		# # #		TRANSFORMERS	J. SPINAS	J. COSTELLO	J. BARD
				MAGNETIC COILS, MAG. AMPLIFIER	J. MURRAY	B. KENERSON	
ATKOMATIC VALVE COMPANY, INC. 545 WEST ABBOTT STREET INDIANAPOLIS 25, IND. HE 8-6545	ATLAS	# # #		SOLENOID VALVES	R. SPEAR	F. THORNELL	R. MORRIS
	dOMARC	#		SOLENOID VALVES	SAME	SAME	SAME
	TITAN	#		SOLENOID VALVES	SAME	SAME	SAME
	JUPITER	#		SOLENOID VALVES	SAME	SAME	SAME
AUTOMATION DYNAMICS CORP. 255 COUNTY ROAD TENAFLY, NEW JERSEY LO 7-3232	POLARIS	# # #		AUTOMATIC TESTER, SUPPORT EQUIP	L. HILLMAN		D. SUHRE
AUTO SPECIALTIES MFG. CO. ST. JOSEPH, MICH. YU 3-2521	NIKE HERCULES LA CROSSE	# #	C	PRECISION FERROUS CASTINGS SAME		H. HARTER SAME	
AUTOMATIC SWITCH CO. 50-56 HANOVER ROAD FLORHAM PARK, N.J. FR 7-4600	dOMARC	#		PILOT & SOLENOID VALVES	B. FRESSOLA	J. CAMPBELL	H. HYLAND
	ATLAS	#		SAME	SAME	SAME	
	TITAN	#		SAME	SAME	SAME	SAME
	NACE	#		SOLENOID VALVES	SAME	SAME	SAME
	POLARIS	#		SAME	SAME	SAME	SAME
	NIKE	#		SAME	SAME	SAME	SAME
	TARTAR	#		SAME	SAME	SAME	SAME
AVCO CORPORATION NEW YORK 17, N.Y. YU 6-5600	POLARIS	LYCOMING DIV. STRATFORD, CONN. DR 8-8211		2ND STAGE CHAMBER			
	TALOS			DIFFUSER			
	TITAN			RE-ENTRY VEHICLE			
	MINUTEMAN			2ND & 3RD CHAMBER			
	NIKE-HERCULES			NOSE CONE			
	TITAN	RESEARCH & DEV. DIV. 201 LOWELL ST. WILMINGTON, MASS. OL 8-8911	G	RE-ENTRY VEHICLE			
	MINUTEMAN		I	SAME			

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
AVIEN• INCORPORATED. 58-15 NORTHERN BLVD• WOODSIDE 77• N•Y• YE 2-8600	TERRIER	#	A	LAUNCHER COMPUTER COMPONENT	H• KOLETSKY	A• SANSONETTI	C• NAPOLITANO
	ATHUTEMA4	#	B	U•C• AMPLIFIER	SAME	SAME	SAME
	HOUND DO•	#	C	GROUND/AIRBORNE CHECKOUT EQUIP•	SAME	SAME	SAME
	TITAN	#		GROUND CHECKOUT EQUIP• COMP	SAME	SAME	SAME
			B				
B-I-F- INDUSTRIES• INC• 385 HARRIS AVENUE PROVIDENCE• RHODE ISLAND GA 1-6302	POLARIS	#	C f	CONTINUOUS PROPORTIONING SYSTEMS	I• MINEL	R• PEARCE	J• SHESHAN
BABCOCK RADIO ENGINEERING INC• 1640 MONROVIA AVENUE COSTA MESA• CALIFORNIA LI-8-7705	30-19	#		RADIO CONTROL SYSTEM	J• UHDE	G• GARGOND	R• LIGGITT
	ARGUS	#		SAME	SAME	SAME	SAME
	ADS-1	#		SAME	SAME	SAME	SAME
	SP-77	#		SAME	SAME	SAME	SAME
	ATLAS	#		TEST EQUIPMENT	R• CECCARINI	SAME	SAME
	TITAN	#		SAME	SAME	SAME	SAME
	POLARIS	#		SAME	SAME	SAME	SAME
	THOR	#		SAME	SAME	SAME	SAME
	LACROSSE	#	F	RANGE SAFETY SYSTEM	T• FISHER	SAME	SAME
BACON INDUSTRIES• INC• 192 PLEASANT STREET WATERTOWN• MASSACHUSETTS WA-4-5070	POLARIS	#		ELECTRONIC ASSYS	J• GREGORY	G• BALLARD	K• BARTON
	ATLAS	#		MOLDED SEALS• PARTS• GASKETS	SAME	SAME	SAME
	HARK	#		POTTING COMPOUNDS	SAME	SAME	SAME
	TITAN	#	d		SAME	SAME	SAME
BAIRD-ATOMIC• INC• 33 UNIVERSITY ROAD CAMBRIDGE 38• MASSACHUSETTS	ATLAS	#	E	INFRARED EQUIPMENT	P• HILL		J•B• MILLIKEN
		#	F	PHOTOSONIC SORTER	J•H• DEMSEY		SAME
	SPARROW III	#	G	INFRARED EQUIPMENT	C• RICHARDSON		SAME
BAKER INDUSTRIAL TRUCKS 8020 BAKER AVENUE CLEVELAND 4• OHIO UL 1-3400	TALOS	#		GROUND SUPPORT EQUIPMENT	C• PRICE(S	B• BARNEY	K• KEYSLEGEN
	POLARIS	#		SAME	SAME	SAME	SAME
	TERRIER	#	C	SAME	SAME	SAME	SAME
BALDWIN-LIMA-HAMILTON CORP• PHILA• NATL BANK BLDG• PHILA• 7• PA• LO4-0720	POLARIS	EDDYSTONE DIV• 3960 STANTON ST• EDDYSTONE• PA• CH3-6211		LAND-BASED LAUNCHERS			
	TITAN	SAME		LAUNCHERS & MEASUREMENT SYS•			
	ATLAS	ELECT• & INST• DIV• WALTHAM 54• MASS• TW4-5700		SAME			
	TITAN	SAME		GROUND HANDLING			
	THOR	SAME		MISSILE FIRING SYS•			
	MATADOR	AUSTIN-WESTERN WORKS 601 FARNSWORTH AVE• AURORA• ILL• AU7-9755					
	TITAN	HAMILTON DIV• 345 3d STR• ST• HAMILTON• OHIO TW4-6511		MACHINE TOOLS• MISSILE COMP			
	POLARIS	LUKEY-HYDROPRESS DIV• 111 FIFTH AVE• NEW YORK 3• N•Y• OR7-50300		SHIP MOTION SIMULATOR			
	JUPITER	ELECT• & INST• DIV• WALTHAM 54• MASS TW4-6700		GROUND TESTING			
BALLYMORE COMPANY LINCOLN & GARFIELD AVENUES WEST CHESTER• PENNA• OR-6-3650		#	A	GROUND SUPPORT EQUIPMENT	P•V• TESTER	R•L• DOHAN	L•E• HEPPER
BARBER-COLMAN COMPANY P• O• DRAWER 99 ROCKFORD• ILL• WO 8-6833		AIRCRAFT CON• DIV• 1800 ROCK ST• ROCKFORD• ILL• WO 8-6833		GROUND CONDITIONING CONTROL SYS FOR: THOR• POLARIS• ATLAS• MIN UTEMAN• MACE• MATADOR• QUAIL• TITAN• SPARROW• TOS• FIREBEE•	H• SHATSWELL		
		ELECTRICAL COMP• DIV• 1800 ROCK ST• ROCKFORD• ILL• WO 8-6833		MOTORS• GENERATORS AND RELAYS FOR: HONE• BOMARC• REDSTONE• JUPITER• PERSHING			
BARCO MANUFACTURING COMPANY• 500-530 NORTH HOUGH STREET BARRINGTON• ILLINOIS DU 1-1700	ATLAS	#		LIQUID OXYGEN• HYDRAULIC JOINTS			
	THOR	#		LIQUID OXYGEN JOINTS			
	TITAN	#		LIQUID OXYGEN & FUEL JOINTS			
BARDEN ENTERPRISES 13718 BURBANK BOULEVARD VAN NUYS• CALIFORNIA ST 2-5263	ATLAS	#	A	TECHNICAL MANUALS	A• JONES	P• BARDEN	P• BARDEN
	SPARK	#	A	SAME	SAME	SAME	SAME
BARKSDALE VALVES 5125 ALCOA AVENUE LOS ANGELES 58• CALIF• LU 9-6181	NIKE HERCULES	#	B	VALVE	R• SIMONIN	H• LEMBKE	H• LEMBKE
	HARK	#	A	SAME	SAME	SAME	SAME
	ATLAS	#	A	SAME	SAME	SAME	SAME
	BOMARC	#	A	SAME	SAME	SAME	SAME
	TITAN	#	B	SAME	SAME	SAME	SAME
JOHN S• BARNES CORPORATION 301 SOUTH WATER ST• ROCKFORD• ILLINOIS WO 8-5631		#	A	GROUND CIRCUIT EQUIPMENT	S•H• STONE	R• CARLSON	J• OLSON
BEARING INSPECTION• INC• 3311 EAST GAGE AVENUE HUNTINGTON PARK• CALIF• LU 2-6431		#	C	TESTING & INSPECTION	S• MATHESON	C• MCKNIGHT	

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
BECKMAN & WHITLEY, INC. 993 P. SAN CARLOS AVE. SAN CARLOS, CALIF. LY 3-7074	SIDEWINDER	MISSILE PROD. DIV.	A	DESIGN & DEVELOPMENT			F. KERR
	HAWK	SAME	C	DESTRUCTORS			SAME
	MERCURY	SAME	H	DISCONNECTS			SAME
	SCOUT	SAME	A	SAFE & ARM DEVICES			SAME
	MACE	SAME	H	DISCONNECTS			SAME
	MINUTEMAN	SAME	C	SAFE & ARM DEVICES			SAME
	TITAN	SAME	A	INITIATORS			SAME
	TITAN	SAME	A	EXPLOSIVE BOLT CARTRIDGES			SAME
	TERRIER	SAME	C	SAFE & ARM DEVICES - SUSTAINER			SAME
	HOUND DOG	SAME	B	DESTRUCTORS			SAME
	PERSHING	SAME	A	DISCONNECTS			SAME
BECKMAN INSTRUMENTS, INC. 2500 FULLERTON ROAD FULLERTON, CALIF.	MERCURY	SCIENTIFIC & PRO. INST. DIVISION	I	CARBON DIOXIDE SENSOR	J. LEONARD	J. LEONARD	
	POLARIS	SAME		OXYGEN SENSOR	W. JOHNER	W. JOHNER	
		SYSTEMS DIVISION 325 MILLER ST.	D	ATMOSPHERE ANALYZERS	W. LINTON	E. MURPHY	K. SPUNER
		ANAHEIM, CALIF. PR 4-5430	C	HIGH SPEED DATA REDUCTION EQ.	K. MILLER	B. ROSENAST	J. MCKNIGHT
	MINUTEMAN	SAME	D	CHECK OUT EQUIPMENT	K. MILLER	B. ROSENAST	J. MCKNIGHT
	ATLAS	SAME	C	HIGH SPEED DATA EQUIPMENT	L. HORWITZ		
BELL AIRCRAFT CORPORATION	DISCOVERER	NIAGARA FRONTIER DIV. POST OFFICE BOX 1		SECOND STAGE ROCKET ENGINE	D. FELT	J. GOEHRINGER	P. LOUGHLIN
BUFFALO 5, NEW YORK BU 5-7551		BUFFALO 21, N.Y. BU 5-7551					
	MERCURY	SAME		REACTION CONTROLS	T. CALLAHAN	SAME	SAME
	CENTAUR	SAME		SAME	A. GORGATY	SAME	SAME
	SERGEANT	AVIONICS DIV. BUFFALO 21, N.Y.		ACCELEROMETER			
BELL & HOWELL COMPANY 7100 MCCORMICK ROAD CHICAGO, ILL. AM 2-1600		"	G	PHOTO INSTRUMENTATION	J. GUATLEMAN	H. PETERSON	S. KRAUS
BELL TELEPHONE LABS WHIPPANY, N.J. TU 7-1000	NIKE ZEUS	"		SYSTEM			
	TITAN	"		COMMAND GUIDANCE SYSTEM			
	NIKE HERCULES	"		TRACKING & COMMUNICATIONS			
	MERCURY	"					
BENDIX AVIATION CORP. FISHER BLDG. DETROIT 2, MICH. TRS-5000	PERSHING	ECLIPSE-PIONEER DIV. TETERBORO, N.J. AT 8-2000		GUIDANCE	D. DECORNER	H. PALMER	A. CLARA
	X-30	"					
	EAGLE	BENDIX SYSTEMS DIV. 3300 PLYMOUTH ROAD ANN ARBOR, MICH. NO 5-7766		AUTO PILOT WEAPON SYSTEM			
	TALOS	BENDIX PROD. DIV. MISS. 400 S. BEECH ST. MISHAWAKA, IND. BL 5-2111	H	COMPLETE SYSTEM	J. MILLER	A. KUPPE	D. YOUNGERMAN
	JUPITER	BENDIX FUNDIES		AUX. POWER SUB-SYS.			
		TETERBORO, N.J. AT8-2000					
	HAWK	ECLIPSE PIONEER DIV. TETERBORO, N.J. AT8-2000		RADAR & CHECKOUT EQUIPMENT			
	PERSHING	SAME		GUIDANCE			
	NIKE-ZEUS	HAMILTON DIV. HAMILTON, OHIO TW3-6181		HYDRAULIC ACTUATOR ASSY.			
	DYNA-SOAR	BENDIX PACIFIC DIV. 11600 SHERMAN WAY					
	TARTAR	SAME		FUSE			
	TERRIER	SAME		HYDRAULICS & AIR MOTOR			
	CROSSBOW	SAME		TELEMETERING			
	LOKI	BENDIX PROD. DIV. MISS. 400 S. BEECH ST. MISHAWAKA, IND. BL 5-2111		LAUNCHER			
	TALOS	SAME		PROPULSION & CONTROL			
	AN/ARD-13	BENDIX SYSTEMS DIV. 327 S. 4TH ST. ANN ARBOR, MICH. NO 5-6111		WEATHER RECORDING SYS.			
	DYNA-SOAR	SAME		COMMUNICATIONS TELEMETERING			
	SPARROW I	YORK DIV. YORK, PA. Y02-2411		FUSE			
	SONAC	SAME		SAME			
	TALOS	BENDIX RADIO DIV. BALTIMORE, MD. VA3-2200		GUIDANCE SYSTEM			
	TALOS	FRIEZ INSTRUMENT DIV. 1400 TAYLOR AVE. TOWSON, MD. VA3-4040		PROPULSION			
	HERCULES I			GUIDANCE			
	TARTAR			FUSE			
	EAGLE			WEAPON SYSTEM			
	JUPITER	BENDIX FILTER DIV. MADISON HGTS., MICH.		HYDRAULIC FILTERS			
	JUPITER	BENDIX UTICA DIV. UTICA, N.Y.		HIGH PRESSURE SPHERES			
	STEER			DEV. OF POLAR ORBIT SATELLITE			
	EAGLE	BENDIX PACIFIC DIV. 11600 SHERMAN WAY		GUIDANCE & CONTROL			
	JUPITER	SAME		CONTROLLER			
	JUPITER	BENDIX SYSTEMS DIV. 327 S. 4TH ST. ANN ARBOR, MICH. NO5-6111		REACTION CONTROLLER			
	EAGLE	SAME		PRIME CONTRACT			
	ATLO	SAME		SAME			
	PERRY	SAME		SAME			
	MERCURY	FRIEZ INSTRUMENT DIV. 1400 TAYLOR AVE. TOWSON, MD. VA3-4040		RADAR, TELEMETRY			

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million	

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
	dONARC	SAME		FUSE, INSTRUMENTATION			
	MERCURY	BENDIX RADIO DIV. E. JOPPA RD. BALTIMORE 4, MD. VA 3-2200		RADAR COMMUNICATIONS CONTROL EQUIPMENT			
	NOTUS	SAME		GROUND TERMINALS			
	TALOS	SAME		CONTROL UNIT			
BENNETT MFG. CO., INC. RAILROAD STREET ALDEN, NEW YORK NF 7-9141	NIKE	#	C	CHASSIS FRAMES	R. BERTON	W. KILIAN	J. NIDE
BENDIX AVIATION CORP., INC. 50 WEST 44TH STREET NEW YORK, N.Y. MU 2-2700	SPARROW III	BATESBURY MFG. DIV. 30 CHERRY AVENUE BATESBURY, CONN. PL 6-4621	E	LAUNCHERS	W. CANNING	M. BEHAN	R. GROSSMAN
	SIDEWINDER	SAME	E	LAUNCHERS ELECTRONIC POWER SUPPLY	SAME	M. BEHAN	SAME
THE BENSON MFG. CO. 1811 AGNES AVENUE KANSAS CITY 27, MO. BE 1-8300	POLARIS	#	B	GROUND SUPPORT	L. CAMPBELL	W. THORNE	W. GUPE
BENTLY SCIENTIFIC CO. 2811 SEVENTH ST. PENKELEY 10, CALIF TH 3-6306		#	B	DISTANCE DETECTORS	D. BENTLY	W. LAUGHLIN	F. SOMMERS
BILL JACK SCIENTIFIC INST. CO. 143 CEDARS AVENUE SOLANA BEACH, CALIF. SK 5-1[illegible]	TITAN	#		FREQUENCY CONVERTER (AM MOTOR	A. KRISTMAN	C. LYMAN	P. SOLECOMEN
	SNARK	#		DC SERVO MOTOR	SAME	SAME	SAME
	TITAN	#		HYDRAULIC PUMP	SAME	SAME	SAME
	dONARC	#		SAME	SAME	SAME	SAME
	HOUND DOG	#		MOTOR-GENERATOR	SAME	SAME	SAME
BLACO MFG. CO. 6581 EUCLID AVENUE CLEVELAND 3, OHIO EX 1-0497	ATLAS	#	A	ROCKET	S. HAPETIK	L. MCCULLEY	P. MCCULLEY
		#					
		#					
E. W. BLISS COMPANY 1372 RAFF ROAD S.W. CANTON, OHIO GR 7-3471	MINUTEMAN	#	E	COMPONENT MANUFACTURE	C. SMITH	G. AIT	P. MAYER
		#					
		#					
BLOOMINGDALE RUBBER CO. ABERDEEN, MD. 2050		#	B	STRUCT. ADHESIVES	R. RAAB	L. BRITTON	J. RUSSELL
		#					
BLUE M ELECTRIC CO. 138TH & CHATHAM ST. BLUE ISLAND, ILL. FU 5-9400		#		ENVIRONMENTAL & COMPONENT TEST EQUIPMENT	J. LAMLER	A. AMLEITNER	W. BILDE
BOEING AIRPLANE CO. P.O. BOX 3707 SEATTLE, WASH.	MINUTEMAN	AERO-SPACE DIV. 7755 E. MARGINAL WAY SEATTLE 24, WASH. JU 6-2121		LAUNCH CONTROL COMMUNICATIONS	W. OWEN	K. ANDERSON	E. SWANSON
	dONARC	MISSILE PROD. CENTER 4734 MARGINAL WAY SEATTLE, WASH. JU 6-2121		COMPLETE SYSTEM	R. HELBERG	K. OELSON	F. AKIN
	DYNA-SOAR	AERO-SPACE DIV. 7755 E. MARGINAL WAY SEATTLE 24, WASH.		SYSTEM MANUFACTURER	J. SMILDE		
BORG WARNER CORPORATION 310 S. MICHIGAN AVENUE CHICAGO, ILL. WA 2-7700	VIGILANTE	BORG ELECTRONICS 3390 MEHARRY BLVD. SANTA ANA, CALIF. KI 5-5581	C	GROUND SUPPORT	J. KINNELL	F. HARKUM	H. SCHUYLER
	dONARC	SAME	B	SAME	SAME	SAME	SAME
	ATLAS	SAME	B	SAME	SAME	SAME	SAME
	PERSHING	INCARSOLL-KALAMAZOO DIV. 1410 N. PITCHER ST. KALAMAZOO, MICH. FI 5-5501	C	MOTOR CASES	J. SCHIEFEL	F. CAMERON	H. MORSE
	TALOS	SAME	B	SAME	SAME	SAME	SAME
	TALOS	SAME	D	DIFFUSER	SAME	SAME	SAME
	TERRIER	SAME	C				
	SPARK	SAME	C				
	CENTAUR	PESCO PROD. DIV. 3310 VANDEN ST. BURBANK TH 5-7611	A	STATIC INVERTER	A. PUREK	H. HEIMER	J. J. ROCCA
	MINUTEMAN	SAME	B	SAME	SAME	SAME	SAME
	MACON	SAME	B	SAME	SAME	SAME	SAME
	GREEN GUATL	SAME	C	PERMANENT MAGNET ALTERNATOR	SAME	SAME	SAME
	TITAN	SAME	A	ROTARY INVERTER	SAME	SAME	SAME
	dONARC	SAME	C	FREQUENCY CONVERTER	SAME	SAME	SAME
	SUB ROC	SAME	A	PERMANENT MAGNET ALTERNATOR	SAME	SAME	SAME
		SAME	A	SAME	SAME	SAME	SAME
BOURNS LABORATORIES, INC. P.O. BOX 2112 RIVERSIDE, CALIF. OV4-1700	JUPITER	#		PRECISION RESISTORS			
BOZUNG, J.A. COMPANY 9401 WHITMORE STREET ROSEMEAD, CALIF. CU 3-8247		#	A	TUBULAR PRODUCTS GROUND HANDLING EQUIPMENT	R. BOZUNG	G. WING	J.A. BOZUNG
		#	A	CONDUIT FITTINGS AIR FRAME	SAME	SAME	SAME
		#	B	DUCTING & OIL LINES AIR FRAME	SAME	SAME	SAME
BRANDSTROM ELECTRIC CO. BOX 339 RIDGEFIELD, CONN. LI 8-8391		#	C	RELAYS VALVES COLLECTOR ASSYS	F. BRANDSTROM	J. HARRINGTON	J. HARRINGTON

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
BRIDGEPORT BRASS CO. 30 GRAND ST. BRIDGEPORT, CONN.	SUBROC	HUNTER-DOUGLAS DIV. 3016 KANSAS AVE. RIVERSIDE, CALIF. OVJ-3030		PROPULSION PARTS			
	ZUNI SIDEWINDER	SAME SAME		ROCKET MTR. TUBES PROPULSION PARTS			
BROOK MOLDING CORP. 30 INDUSTRIAL WAY NORWOOD, MASS. NO 7-4715	TERRIER	"	B	PLASTIC COMPONENTS	F. STAUFFER	F. SMITH	F. SMITH
BROOKS & PERKINS INC. 1950 W. FORT ST. DETROIT 16, MICHIGAN TA 5-5400	TALOS	"		AIRFRAME SECTIONS			
	ATLAS BOMARC FALCON	" " "		TANKS SAME TAIL SECTIONS			
BROWN ENGINEERING CO. 1312 MERIDIAN ST. HUNTSVILLE, ALA. JE 6-9041	LITTLE JOHN	"	C	GROUND SUPPORT			
	REDSTONE	"	E	SAME			
BROWN LINE CORPORATION 111 MAIN EL SEGUNDO, CALIF. EA 2-2437	TITAN	"	A	SAFETY NETS	A. SCHWARTZ	G. PARR	A. TLONGAN
THE BRUNSWICK-BALKE-COLLENDER CO. MUSKEGON, MICHIGAN 2-6081		DEFENSE PROD. DIV. MARION, VA. STATE 3-7111	E	PLASTIC RADOMES & NOSE CONES	W. COX	C. SCOTT	E. SPITZER
		SAME	C	RADOME	C. RUGGLES	C. SCOTT	K. ARELL
	NIKE	SAME	C	RADAR HOUSING	R. BARGER	C. SCOTT	K. ARELL
	A 2 F	SAME	E	ROTODOME	R. BARGER	C. SCOTT	K. ARELL
	BOMARC	SAME	E	NOSE	T. PARKER	C. SCOTT	K. ARELL
		"	E	PLASTIC THRUST CHAMBERS	J. UPPNO	A. FERGUSON	R. JARMAN
		"	E	FINS, WINGS, AILERONS, ETC.	J. UPPNO	A. FERGUSON	R. JARMAN
BRUSH BERYLLIUM #201 PERKINS AVE. CLEVELAND, OHIO EN 1-5400	MERCURY	"		BERYLLIUM SHIELD			
BRYANT COMPUTER PROD. DIV. 123 MAIN STREET SPRINGFIELD, VERMONT 5-2141	POLARIS	"	C	MAGNETIC STORAGE DRUMS	R. STOVER	W. FUZNER	F. DELANGER
	PERSHING	"	C	SAME	SAME	SAME	SAME
BULO STANLEY CO., INC. 43-01 24 STREET LONG ISLAND CITY, N.Y. ST. 6-1706	BOMARC	"	B	ANTENNAS	E. MEYERS	B. UNBURG	MAC LEAD
	FALCON	"	A	SAME	SAME	SAME	SAME
	LITTLE JOHN	"	A	SAME	SAME	SAME	SAME
BULOVA WATCH CO., INC. FLUSHING 70, N.Y. OE 5-6000	PERSHING	BRL. RES. & DEV. LAB. ABERDEEN 77, N.Y. NE 4-5700	E	WARHEAD SAFETY AND ARMING	S. SPIELBERGER	A. LAZAR	S. STONE
	TERRIER	SAME	C	SAFETY AND ARMING	C. CRESCAS	H. JACKSON	H. MURPHY
	CORVUS	SAME	D	SAME	SAME	S. SCHULMAN	SAME
	TALOS	SAME	C	SAFETY AND ARMING WARHEAD TAN.	SAME	K. CARUSO	SAME
	JUPITER	SAME	C	ACCELEROMETER MONITOR (GLE)	N. ALPERT	H. SCHIMPF	SAME
	SIDEWINDER	SAME	U	SAFETY AND ARMING	C. CRESCAS	A. GORCHERT	SAME
	EXPLORER	IND. & DEF. DIV. FLUSHING 70, N.Y. DE 9-6000		ELECTRONIC TIMER	R. BENNETT	U. STAMBAUGH	T. LEWIS
	GALLANT	SAME		FUZE TRIGGERING DEVICE	L. MARTIN	H. JACKSON	SAME
	GALLANT	SAME	D	COMMUNICATIONS FREQUENCY CONTR	T. MATIASIC	F. CHELI	SAME
	HAWK	SAME	C	SAME	A. STRAUSS	SAME	SAME
BULOW ELECTRIC COMPANY 11000 CAPITAL AVENUE OAK PARK, MICH. LI-7113	JUPITER	"	C	CHECKOUT, TEST, GROUND SUPPORT	L. PATRICK	W. GULF	C. GALEA
BURNER-MOLLOMON MFG. CORP. 4706 RHODE ISLAND AVE. HYATTSVILLE, MD. UN 4-5401		"	D	GROUND SUPPORT EQUIPMENT	C. HAMSCELL	F. MOLLOMON	F. MOLLOMON
BURNS AND ROE, INC. 160 WEST BROADWAY NEW YORK 13, N.Y. RE 2-7000	NIKE-ZEUS	"		GROUND SUPPORT			
	SAGE MERCURY	" "		A.E. FACILITIES DESIGN A.E. DESIGN-CONSTRUCTION OF TRACKING SITES			
BURROUGHS CORPORATION 6071 SECOND AVE. DETROIT 25, MICH. TH 5-2440	SAGE	MILITARY ELECTRONICS DIV. 14965 TIREMAN DETROIT, MICH.	J	LOGISTAT DATA TRANSMITTERS		E.B. SCHENING	
	ATLAS	SAME	I	I.C.B.M. GUIDANCE COMPUTERS		SAME	
	ALRI (SAGE)	BURROUGHS RES. CTR. GREAT VALLEY, PA.	G	SYSTEM MANAGER	C. REGISTER		
	POLARIS	SAME	E	STABILIZATION DATA COMPUTER	K. MCILVAIN		
BUTLER MFG. CO. 7400 E. 13TH ST. KANSAS CITY, MO. HE 1-7400	JUPITER	"		GROUND SUPPORT			
		"					
		"					
	REDSTONE	"		SAME			
	BOMARC	"		SUPPORT EQUIPMENT			

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million	

Contractors' Directory

C

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
C & K COMPONENTS, INC. 101-103 MORSE ST. NEWTON 58, MASS. BA 6-0800	POLARIS	"		LOGIC MODULES-MAGNETIC SHIFT REGISTERS	C. COOLIDGE	F. HOBBS	L. GREENBLATT
CADILLAC GAGE CO. P.O. BOX 3069 DETROIT 5, MICHIGAN PR 7-7100	JUPITER ATLAS THOR TITAN	" " " "		HYDRAULIC CONTROL SYS. SAME SAME SAME			
CALCOR CORP. 1019 W. PHILADELPHIA ST. WHITTIER, CALIF. CA 1-1131	JUPITER ATLAS THOR BOMARC	" " " "		CONSOLES, CABINETS, MOUNTS SAME SAME SERVO VALVES			
CALIFORNIA AIRCRAFT PRODUCTS 790 GREENFIELD DRIVE EL CAJON, CALIFORNIA HI 2-3491	POLARIS ATLAS TITAN THOR MINUTEMAN	" " " " "	C C D C D	CHAMBER HEAD ASSEMBLIES, BELLOW GROUND HANDLING EQUIPMENT VERNIER DUCTS, MOTOR TUBING DUCTS & BELLOWS ASSEMBLIES NOZZLES & CHAMBER HEAD	L. RUSSELL A. KNEPP L. RUSSELL L. RUSSELL L. RUSSELL	M. BRATTON M. BRATTON M. BRATTON M. BRATTON M. BRATTON	G. COLES G. COLES G. COLES G. COLES G. COLES
CAMBRIDGE CORP. 2 INDUSTRIAL PARK LOWELL, MASS. GL 4-7081	JUPITER	"		LOX TRAILERS			
	ATLAS THOR	" "		LOX PUMPING SYS. LOX TANKS			
CAMERA EQUIPMENT COMPANY, INC. 315 WEST 43RD STREET		JOHN A. BAUDELL INC. SYRACUSE, N.Y. ARLINGTON-WATSON ROCHESTER, N. Y.	B B A A	HI-SPEED STREAK CAMERA & ACC CAMERA AND ACCESSORIES SAME SAME	J. BAUDELL SAME SAME SAME	P. IPPOLITO SAME SAME SAME	A. IPPOLITO SAME SAME SAME
CAPITAL CITY MFG. CO., INC. 857 KING AVE. COLUMBUS 12, OHIO. AX 9-2140		"	C	ACTUATION SYSTEMS, NOZZLES	W. CARPENTER	R. BEE	C. BAILEY
CARLETON AVIATION COMPANY, INC. EAST AURORA, NEW YORK CY 4836	BOMARC CORVUS MERCURY IPLOS, SUPER	" " " "	A A A A	FUEL PRESSURE REG. PRESSURE SWITCH OXYGEN REGULATOR FUEL PRESSURE REG.	G. ORD SAME SAME SAME	W. ORELL SAME SAME SAME	J. SHIMER SAME SAME SAME
CARLING ELECTRIC, INC. 505 NEW PARK AVE. WEST HARTFORD 10, CONN. AU 2-4841		"	C	SWITCHES	W. SORENSON	C. CARLING	
CANNODY CORPORATION 2360 KEMPLE DRIVE BUFFALO 21, NEW YORK SP 7700		"	A	TRAINING SYSTEMS	R. HESS	J. WANZHAF	R. POLLOCK
THE J.C. CARTER COMPANY 671 WEST 17TH STREET COSTA MESA, CALIFORNIA LI 8-3471		"		SPECIAL PURPOSE PUMPS	M. KILMER	C. ALLAN	W. MELO
CASWELL ELECTRONICS CORPORATION 414 QUEENS LANE SAN JOSE 14, CALIFORNIA CY 7-9293	TITAN	"		MICROWAVE COMPONENTS	D. CASWELL	F. WILSON	F. HALL
CEPCO INDUSTRIES INC. 22 HENSCH AVE. CALION, OHIO HO 20727		"	E	GROUND SUPPORT EQUIPMENT	H. ERIN	P. DURTSCHI	H. ERIN
CENTRAL COIL CORP. 10223 GLENWOOD RD. BROOKLYN 36, N. Y. NI 9-1223		"	B	ELECTRICAL COMPONENTS	F. MCLAREN	M. HAFT	P. HAFT
CENTRAL DYNAMICS LTD. 147 HYMUS BLVD. PTE. CLAIRE, QUE., CAN. OX 7-0611	BOMARC	"	A	PNEUMATIC REGULATIONS	H. PRICE	C. MOTT	R. FRIENDSHIP
CERAMASEAL, INC. P.O. BOX 23 NEW LEBANON CENTER, N. Y. NL 3-5041	NIKE	"	B	CERAMIC TERMINALS, BUSHINGS	A. BREDBENNER	P. UST	F. FRANZSON
THE CESSNA AIRCRAFT COMPANY WICHITA, KANSAS MU 4-7741	MINUTEMAN	MILITARY AIRCRAFT DIV.	C	TRANSPORTER, ERECTOR, ENGINE CONTAINER	W. MOORE	O. IRBY	W. GRISAMORE
CHAUDICK-HELMUTH CO. 472 E. DUARTE RD. MONROVIA, CALIF.		"		VIBRATION TEST EQUIPMENT HIGH SPEED PHOTOGRAPHY	J. HELMUTH	R. RUNNELS	R. RUNNELS
CHANCE VOUGHT AIRCRAFT, INC. P.O. BOX 5907 DALLAS 22, TEXAS AN-2-3211	MINUTEMAN	ELECTRONICS DIV. "		SERVO ACTUATORS	L. CHATTLER		R. STEELE
	SCOUT	ASTRON. DIV.			H. GREEN		

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
CHANDLER EVANS CORPORATION CHARTER OAK BOULEVARD WEST HARTFORD, CONN. AD 6-0651	SPARROW 411	#		HYDRAULIC SERVO VALVES-GUIDANCE	J.NASH	J.KOCHANEK	F.DILDINE
	HOUND DOG	#		MAIN FUEL PUMP	A.WRIGHT	T.LINDER	SAME
	QUAIL	#		MAIN FUEL PUMP	SAME	SAME	SAME
	FIREBEE	#		MAIN FUEL CONTROL SYSTEM	SAME	SAME	SAME
	MARK	#		MAIN FUEL PUMP	SAME	SAME	SAME
	504 (DRONE)	#		MAIN FUEL PUMP	SAME	SAME	SAME
CHICAGO AERIAL INDUSTRIES, INC. 1980 HAWTHORNE AVENUE MELROSE PARK, ILLINOIS. FI 5-1440		#		MISSILE GUIDANCE INSTRUMENTATION RECONNAISSANCE SYSTEMS	W.JOHNSON		P.SMITH
CHICAGO PNEUMATIC TOOL CO. 6 EAST 44TH ST. NEW YORK 17, N. Y.	POLARIS	# 2200 PLEEKER UTICA, N. Y.		ACTUATORS AND MOTORS			
CHRISTIE ELECTRIC CORPORATION 3410 WEST 67TH STREET LOS ANGELES, CALIFORNIA. PL 32607		#		POWER SUPPLIES FOR BOMARC, TITAN	S.CHRISTIE	D.JAENECKE	H.DOTY
CHRISTIE MACHINE WORKS 201 HARRISON STREET SAN FRANCISCO 5, CALIF. EX 2-2187	TITAN	#	A	POWERPLANT ROTOR TURBINES	A.CHRISTIE	L.CHRISTIE	E.CHRISTIE
	BULLPUP	#	A	POWER PLANT IMPELLERS	SAME	SAME	SAME
	TITAN	#	A	POWER PLANT NOZZLES	SAME	SAME	SAME
	POLARIS	#	A	POWER PLANT JETEVATORS	SAME	SAME	SAME
	SERGEANT	#	A	HIGHSPEED CAMERAS	SAME	SAME	SAME
	SERGEANT	#	A	POWER PLANT ADAPTOR PLUGS GUIDANCE PARTS	SAME SAME	SAME SAME	SAME SAME
CHRYSLER CORPORATION 341 MASSACHUSETTS AVENUE HIGHLAND PARK, MICHIGAN. TU 3-4500	JUPITER	CHRYSLER MISSILE DIV. P.O. BOX 2628 DETROIT 31, MICH. JE 9-2000		AIRFRAME CHECKOUT EQUIPMENT GROUND HANDLING EQUIPMENT GROUND SUPPORT	V.VEHKO	F.SEANEY	S.ROACH
	REDSTONE	SAME	K	SAME	SAME	SAME	SAME
CIRCON COMPONENT CORP. SANTA BARBARA MUNICIPAL AIRPORT GOLETA, CALIFORNIA. WO 7-1113		#	C	SPECIALIZED COMPONENTS	M.HAINSWORTH	C.D'ROCK	C.SPAFFORD
CLARK EQUIPMENT COMPANY P. O. BOX 31 BUCHANAN, MICHIGAN. OX 5-3611	ATLAS	AUTOMOTIVE DIV. #		GROUND SUPPORT AND EQUIPMENT AIR SUSPENSION	L.GRAY	JACK BERG	J.BOONE
		#					
	MINUTEMAN	#		GROUND SUPPORT AND EQUIPMENT	SAME	SAME	SAME
	NIKE-HERCULES	DEVELOPMENT DIV. BATTLE CREEK, MICH.	B	GROUND SUPPORT	R.ROGERS	K.MINDRUM	G.JOHNSON
	BOMARC	SAME	C	SAME	SAME	SAME	SAME
	RED EUPORT	SAME	C	SAME	SAME	SAME	SAME
CLARY DYNAMICS CORP. 408 JUNIPERO ST. SAN GABRIEL, CALIF. AT 7-611	CORPORAL	#		GYRO & CONTROLS			
	TITAN	#		SAME			
	ATLAS	#		PROPELLANT SYS. VALVES			
CLEVELAND METAL SPECIALTIES CO. 1783 E. 21ST STREET CLEVELAND 14, OHIO PR 1-4186		#	A	COMPLETE SUB-SYSTEM	A.GROSS		J.JAPEL
		#					
		#		FUZE	SAME		SAME
		#		DIGITAL PROGRAM TIMER	SAME		SAME
CLIPPARD INSTRUMENT LAB., INC. 7390 COLERAIN RD. CINCINNATI 39, OHIO JA 1-6241		#		MINIATURE PNEUMATICS & RF COIL	O.CLIPPARD	F.LEROY	J.DILLON
COMU ELECTRONICS, INC. 5 FOTTLER ROAD HINGHAM, MASS. RI 9-4400	POLARIS	MASSA DIV.	C	TRANSDUCERS	F.MASSA	D.FINCKE	R.THOMAS
COLE ELECTRIC CO. 8439 STELLER DRIVE CULVER CITY, CALIF. UP 0-4701		#	E	HEATERS, SWITCHES, CONNECTORS	GERCKENS	GERCKENS	J.TOMASIC
G. L. COLLINS CORP. 2820 E. MULLETT ST. LONG BEACH 3, CALIF. ME 0-3171	MINUTEMAN	#	C	ELECTRO-MECHANICAL TRANSDUCERS	G.COLLINS	R.WOLFE	G.COLLINS
	ATLAS	#	B	ELECTRO-MECHANICAL TRANSDUCERS	SAME	SAME	SAME
	NIKE-ZEUS	#	A	ELECTRO-MECHANICAL TRANSDUCERS	SAME	SAME	SAME
THE COLORADO FUEL AND IRON CORP. 575 MADISON AVENUE NEW YORK 22, N.Y. MU 8-5400	MINUTEMAN	813 WEST STREET WILMINGTON, DEL. SAME	C	MOBILE HANDLING HARNESS	R.YOUNG		J.KNOWLTON
	THOR		D	ALUMINUM ALLOY BULKHEADS	R.ALLEN		H.BEERS
COLUMBIA RESEARCH LABS, INC. MCDADE BLVD. & BULLENS LANE WOODLYN, PA. LE 2-9466		#	D	SHOCK AND VIBRATION TEST WORK	V.ALTMERT	G.GREENE	T.CAREY
		ELECTRONICS DIV.	D	SHOCK AND VIBRATION TEST WORK	G.HARMAN	L.SMITH	S.SAVINESE
COLUMBIA RESEARCH AND DEV. CORP. 4600 INDIANOLA AVENUE COLUMBUS 14, OHIO AM 7-1277	TERRIER	#	A	ASSEMBLY TEST STANDS	H.DOTTS	R.HUNKLER	D.LEHMAN
	TALOS	#	C	CONTROL UNIT TEST BENCH	J.GLASCOCK	R.HUNKLER	D.LEHMAN
COMPONENTS CORPORATION 106 MAIN STREET DENVILLE, N.J. GA 7-0290	JAVELIN	#	A	MINIATURE POWER SUPPLY	J. HINTER	J. PRICHETT	C. BARCLAY

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

*CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
CONRAD, INC. 141 JEFFERSON STREET HOLLAND, MICHIGAN EX 2-3141	"	"	E	TEST EQUIPMENT	D.BENCH	G.PEATTIE	H.POINTER
CONSOLIDATED AVIONICS CORP. 800 SHAMES DRIVE WESTBURY, L.I., N.Y. ED 4-8400	JUPITER	"	C	CONTROL COMPUTER TEST SET	A.CURANZA	E.ORLOFF	C.COOPER
	JUPITER	"	A	AUTOMATIC VALVE TESTER	R.KISSNER	SAME	SAME
	TITAN	"	C	AUTOMATIC DIGITAL COMPUTER TES	Y.LUMKIN	SAME	SAME
	DISCOVERER	"	D	INSTRUMENTATION VAN COMPLEX	G.BINRAM	SAME	SAME
	JUPITER/SATURN	"	C	DATA PROCESSING VAN	G.BINRAM	SAME	SAME
	POLARIS	"	C	AUTOMATIC TEST EQUIPMENT	G.RABIN	SAME	SAME
	ATLAS	"	C	AUTOMATIC TEST EQUIPMENT	F.RATOWSKY	E.ORLOFF	C.COOPER
	MINUTEMAN	"	H	TELEMTRY DATA PROCESSING SYS	G.BINRAM	SAME	SAME
	JUPITER/ PERSHING	"	G	TIME INTERVAL COMPUTER	F.SIEGEL	SAME	SAME
CONSOLIDATED CONTROLS CORP. BETHEL, CONN. PI 3-6721	SCOUT	"	A	PRESSURE CONTROLS	R.SPICER	E.WOODWORTH	C.JOYCE
	MERCURY	"		PRESSURE CONTROLS	J.HALL	SAME	SAME
	NIKE-HERCULES	"		PRESSURE CONTROLS	R.SPICER	SAME	SAME
	TITAN	"		GROUND CONTROLS	J.FONTANA	SAME	SAME
CONSOLIDATED DIESEL ELECTRIC CORP. 880 CANAL STREET STAMFORD, CONN. DA 5-2281	QUAIL	"	H	GROUND POWER	A.A. SACKLER	E. J. MINAR	J. ADAMS
	LACROSSE		C	GROUND TEST	SAME	SAME	SAME
	NACE		C	GROUND POWER	R. WINSLOW	SAME	SAME
	DISCOVERER	"	J	613-MEDICAL COMPLEX	A. A. SACKLER	SAME	SAME
	NIKE AJAX	"		GROUND POWER UNITS	SAME	SAME	SAME
	CORPORAL	"		SAME	SAME	SAME	SAME
	NIKE HERCULES.	"		SAME	SAME	SAME	SAME
CONSOLIDATED WESTERN STEEL 5700 S. EASTERN AVE. LOS ANGELES, CALIF. TH 6-1073	LITTLE JOHN	"		POWERPLANT			
	ATLAS	"		GR. HAND. & LAUNCHING			
	THOR	"		SAME			
	NIKE-AJAX	"		SAME			
	NIKE-HERCULES	"		SAME			
	MINUTEMAN	"		SAME			
CONTINENTAL AVIATION AND ENG. CORP. 12700 KERCHEVAL DETROIT, MICH. VA 2-1300	FIREBEE JET	TOLEDO DIVISION 1930 LASKEY ROAD TOLEDO, OHIO		POWERPLANT	J.DEREMER	G.BLUTH	J.WATSON
CONTROLS FOR RADIATION, INC. 130 ALEXIFF BROOM PARKWAY CAMBRIDGE 42, MASS. UN 4-8490	ATLAS	"	H	SPACE RADIATION PROBES	J.BALL	P.RUSSO	D.SOMERS
CONVAIR-DIV. GENERAL DYNAMICS CORP. 3165 PACIFIC HIGHWAY SAN DIEGO 12, CALIFORNIA CY 6-6011	ATLAS	CONVAIR-ASTRONAUTICS 5001 KEARNY VILLA RD. SAN DIEGO 12, CALIF.	A	AIRFRAME, AUTOPILOT	C.AMES JR.	W.YOUNG	E.FELLOWS
	AZUSA	SAME	A	BASE ACTIVITIES	G.ARMSTRONG	SAME	SAME
	ATLAS-AGENA	SAME	A	BOOSTER	D.DAVIS	SAME	SAME
	CENTAUR	SAME	A	ATLAS 1ST & 2ND STAGE	P.CULPEPPER	SAME	SAME
	MERCURY	SAME	A	ATLAS BOOSTER FOR MERCURY	SAME	SAME	SAME
	TERRIER	CONVAIR-POMONA 1675 W. FIFTH POMONA, CALIF. NA 9-5111	A	AIRFRAME AND ELECTRONICS	C.MCCABE	R.LOOMIS	R.WEBSTER
	TARTAR	SAME	A	AIRFRAME AND ELECTRONICS	H.HARRY	R.LOOMIS	R.WEBSTER
	MED-EYE	SAME	A	RESEARCH AND DEVELOPMENT	A.E.PALMER		P.WEBSTER
FRANK R. COOK COMPANY 3850 OLIVE STREET DENVER 7, COLORADO DU 8-4836		"	E	POWER SUPPLIES FOR ATLAS, POLARIS	D.SCURLOCK	J.PUSCH	G.MARTINE
COOK BATTERIES, SUB OF TELECOMPUT 3850 OLIVE STREET DENVER 7, COLORADO DU 8-4836	ATLAS	"		SILVER-ZINC BATTERIES	D.SCURLOCK	J.PUSCH	E.MARTINE
	POLARIS	"		SAME	SAME	SAME	SAME
	MINUTEMAN	"		SAME	SAME	SAME	SAME
	ADAM	"		SAME	SAME	SAME	SAME
	TITAN	"		SAME	SAME	SAME	SAME
	WHITE LANCE	"		SAME	SAME	SAME	SAME
COOPER DEVELOPMENT CORP. 2626 S. PECK RD. MONROVIA, CALIF. HI 4-3178	ASP	"		SOLID PROP. ROCKETS			
	JUPITER	"		NOSE CONE			
	BASP	"		AIRFRAME, PROPULSION			
	ASPAN	"		DEVELOPMENT			
	HASP	"		SAME			
CONTINENTAL DIAMOND FIBRE NEWARK, DELAWARE EN 8-8531		"		HI-TEMP MATERIALS FOR BOMARC, FALCON, JUPITER, NIKE, POLARIS	F.JAHNS	R.HANDLY	W.WALKER
		BRIDGEPORT DIV. BRIDGEPORT, PENNA. BR 3-0800		INSULATION PARTS FOR PERSHING, SIDEWINDER, SPARROW, SUROC, TITAN		E.HEFFERMAN	
		VALPARISO DIV. VALPARISO, IND. VA 3-2701		PRINTED CIRCUIT BASES FOR ATLAS, QUAIL, TALOS, TYNA-SOAR, SHILLELAGH		M.CAIN	
CORBIN CORPORATION LEVITTOWN, NEW JERSEY	MERS	CORBIN CORPORATION MIAMI, FLORIDA CORBIN CORPORATION BETHESDA, MARYLAND		SYSTEMS	B.SMITH	L.BOREN	J.LEITCH
				SYSTEMS ANALYSIS	E.SMITH		C.CORBIN

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million	

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
CORNELIUS CO. 550 39TH AVE. N.E. MINNEAPOLIS, MINN.	JUPITER	#		SAFETY VALVES			
CORNELL AERONAUTICAL LAB. INC. 4455 GENESSEE ST. BUFFALO 21, N. Y. PL 7500	LACROSSE	#		ENTIRE SYSTEM			
	AC-12AA	#		SYSTEMS ENGINEERING			
	CABLE	#		FEASIBILITY STUDIES			
	VTAE-7611	#		SYSTEMS ENGINEERING			
COTO-COIL CO. INC. 65 PAVILION AVENUE PROVIDENCE 5, RHODE IS. WI 1-3395	MERCURY	#		COILS	L. BELLEM		G. OXX
CRAIG SYSTEMS, INC. 360 MERRIMAC STREET LAWRENCE, MASSACHUSETTS MU 6-6941	MAAK	#		SHELTERS FOR BATTERY CONTROL MAINTENANCE VANS	E. DIPAOLO	F. BRAUNFELD	J. FROST
	THOR	#		SHELTERS FOR POWER CONTROL	E. CHASE	SAME	SAME
				MOBILE COMMUNICATIONS INSTALL	C. CARSON	SAME	SAME
				SAME	SAME	SAME	SAME
				COMMUNICATIONS SHELTER & EQUIP	L. WILLIAMS	SAME	SAME
CRESCENT ENGINEERING AND RESEARCH 5440 NORTH PECK ROAD EL MONTE, CALIFORNIA GI 4-0328		#		MEASUREMENT DEVICES, CONTROL SYS	R. THOMAS	J. BENNETT	J. WACKERMAN
CROKER MANUFACTURING & ENGINEERING 2130 E. 8TH STREET LOS ANGELES 21, CALIF. LU 2-5383	MOUND DOG	#	C	TANK	R. MILLS	D. SEWART	D. FARRER
	MERCURY	#	M	CHAMBER	SAME	SAME	SAME
	POLARIS	#	A	TANK	SAME	SAME	SAME
	AEROBEE	#	C	TANK	SAME	SAME	SAME
	VTAE	#	M	DOLLY	SAME	SAME	SAME
W. PAT CROW, INCORPORATED 200 LUXTON STREET FORT WORTH, TEXAS JE 6-2841		#	E	DROP FORGINGS	F. LEBGETT	S. SLUZEWICZ	E. KLARICH
CUMMINS ENGINE COMPANY, INC. 1000 FIFTH STREET COLUMBUS, INDIANA CA 2-7411	MIKE	#		PRECISE POWER GENERATOR SETS	D. CUMMINS	H. ROBE	R. SEBASTIAN
	THOR	#		SAME	SAME	SAME	SAME
CURTIS LABORATORIES, INC. 2710 GRIFFITH PARK BLVD. LOS ANGELES 27, CALIF. NO 2-1176	MINUTEMAN	#	-1	HEATED OPTICAL WINDOW	E. CURTIS	T. A. CURTIS	T. CURTIS
CURTISS-WRIGHT CORP. SANTA BARBARA 6767 HOLLISTER AVENUE GOLETA, CALIFORNIA HO 7-3411	SKYDART	#		SUPERSONIC TARGET	W. KOCH	F. LEE	R. DAUMILLER
	POLARIS	AERONAUTICAL DIV. ADDRESS: J. J.		MOTOR CASES, VECTOR NOZZLES	R. BOSTACK		
	PERSHING	SAME	D	ROCKET MOTOR CASES		B. HENDERSON	
	MINUTEMAN	SAME	D	SAME		N. FINLA	
CUSTOM COMPONENTS, INC. P.O. BOX 204 CALDWELL, NEW JERSEY CA 6-3403	MIKE	#	A	POLYIRON COMPO.	H. DANZIGER	J. WALTER	
	MAAK	#	A	SAME	SAME	SAME	
CUSTOM SCIENTIFIC INSTRUMENTS, INC. 541 DEVON STREET KEARNY, NEW JERSEY WY 1-6407		#	A	TESTERS AND INSTRUMENTATION	R. NUVOTNY	C. REICHERS	M. SARELLA
CUSTOM TOOL AND MFG. CO. 2201 N. SECOND STREET MINNEAPOLIS 11, MINN. JA 1-3591	POLARIS	#	E	NOZZLES, JETEVATORS	C. ANDERSON	R. WILLIAMS	W. SENN
	MINUTEMAN	#	C	TUNGSTEN PARTS, IGNITER TUBES	SAME	SAME	SAME

D

DBM RESEARCH CORPORATION STODDARD BLDG., ATLANTIC AVE. COCOA BEACH, FLA. SU 3-2478		#	E	INSTRUMENTATION SYSTEMS & SUBS	C. MATTOX	C. STOOPES	C. MATTOX
DAGE ELECTRIC COMPANY, INC. 67 NORTH SECOND STREET BEECH GROVE, INDIANA ST. 6-0456		#	E	COAXIAL CABLE	C. ELLIS	R. ZEHR	E. ZEHR
DALMO VICTOR CO. 1515 INDUSTRIAL WAY BELMONT, CALIF. LY 1-1814	SPARC	#		DRIVE ASSEMBLIES			

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)		$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
DAVIDSON OPTRONICS, INC. 2223 RAMONA BLVD. WEST COVINA, CALIFORNIA	EO7-7281	SCOUT	"	A	OPT-ELECTRONIC ALIGNMENT SYS	E.KONST	A.BENGSTON	O.A.KIDWELL
		PERSHING	"	B	SAME	J.TRIPLETT	SAME	SAME
		MINUTEMAN	"	A	SAME	E.KONST	SAME	SAME
		THOR	"	B	SAME	E.AVETTA	SAME	SAME
		ATLAS	"	B	SAME	J.TRIPLETT	SAME	SAME
DEBELL & RICHARDSON INC. PLASTICS RES.& DEV. LAB. HAZARDVILLE, CONNECTICUT	RI9-8301	POLARIS	"	C	PLASTIC FILAMENT WOUND STRUCT	W.J.EAKINS		
			"	B	GLASS FABRICS	W.J.EAKINS		
			"	B	RADOMES FOR TRACKING	M.MEAD		
DEFIANCE MACHINE & TOOL CO. 1920 S. VANDEVENTER AVE. ST. LOUIS 10, MO.	PR 3-0067		"		MARKING EQUIPMENT	P. A. DERRICER		
DEFIANCE PRINTED CIRCUIT CORP. 81 ALBION ST. WAKEFIELD, MASS.	CR6-5311	HAWK	"	A	PRINTED CIRCUITS	T.DANDO	J.WHEELER	K.JUEL
		MINUTEMAN	"	A	PRINTED CIRCUITS	T.DANDO	J.WHEELER	K.JUEL
DELAVAN MFG. CO. 811 - 4TH STREET WEST DES MOINES, IOWA	CR 4-1561			B	FUEL INJECTION NOZZLES	H. HATHAWAY	P. TAMASI	W. STROEBER
DESIGNERS FOR INDUSTRY, INC. 4241 FULTON PARKWAY, S.W. CLEVELAND, OHIO	SH9-0700	JUPITER	"		FREQUENCY CONTROL UNITS			
		VANGUARD	"		PROGRAM TIMER			
		JUPITER	"		GROUND SUPPORT EQUIPMENT			
		REDSTONE	"		GROUND SUPPORT EQUIPMENT			
THE DEUTSCH CO. 70TH & AVALON LOS ANGELES, CALIF		JUPITER	ELECTRONIC COMP. DIV. BANNING, CALIF.		ELECTRICAL CONNECTORS	C.DOUGLAS	W.MYERS	M.BROWN
		NIKE SYS.	"		SAME	SAME	SAME	SAME
		THOR	"		SAME	SAME	SAME	SAME
		GOMARC	"		SAME	SAME	SAME	SAME
		ATLAS	"		SAME	SAME	SAME	SAME
		POLARIS	"		SAME	SAME	SAME	SAME
DEVILBISS METAL FABRICATORS CO. 5741 RUSSELL ST. DETROIT 11, MICH.	TR3-2100	SAGTAIL	MISSILE DEVELOPMENT 1915 ARMACOST AVE. W. LOS ANGELES, CALIF.		SHIPPING CONTAINERS	J.CORNELIUS	R.RUPP	E.KESSELRING
DIAMOND ORDNANCE FUSE LAB. CON. AVE. & VAN NESS, WASHINGTON 25, D.C.	EM2-8000	TALOS	"		FUSE			
		PARRIER	"		SAME			
DIGITRONICS CORP. ALBERTSON AVE. ALBERTSON, NEW YORK	PI7-5090			B	DIGITAL EQUIP. TAPE CONVERTER	M.SKRIVANEK	W.COHEN	M.SIEGELBAUM
DORR AND MARGOLIN, INC. 29 NEW YORK AVE. BESIPURT, NEW YORK	ED4-3200	GAM 72	"		ANTENNAS	R.ANDERSON	R.BUDD	J.ESCALETTE
		GAM 77	"		SAME	SAME	SAME	SAME
DOUBLE E PRODUCTS CO. 208 STANDARD ST. EL SEGUNDO, CALIF.	EA2-2501	MINUTEMAN	"	C	FILTERS, RADIO INTERFERENCE	S.TRIER	S.ALLEN	J.TRIER
DOUGLAS AIRCRAFT CO., INC. SANTA MONICA, CALIF.	EX 9-9311	NIKE HERCULES	CHARLOTTE, N.C.		AIRFRAME, ASSEM. & TEST	W. BEMBOW	S. SMITH	W. G. DURAN
		NIKE ZEUS	SANTA MONICA, CALIF.		SAME	J. BROMBERG	L. CARTER	SAME
		THOR	"		SAME	H. THOMAS	SAME	SAME
		HONEST JOHN	"		SAME	L. E. STOCKING	SAME	SAME
		GAM 87	"		RESEARCH	J. JORGENSEN	SAME	SAME
		DELTA	"		PRIME CONTRACTOR	T. GORDON	SAME	SAME
		DISCOVERER	"		1ST STAGE THOR LAUNCH OPERAT	W. TIETJEN	SAME	SAME
DOUGLAS MICROWAVE CO., INC. 252 E. 3RD. ST. MT. VERNON, NEW YORK	MO8-6900	BEACON	"	B	MICROWAVE INSTRUMENTATION	R.DOUGLAS	H.GORDON	L.GEIER
DOW CHEMICAL COMPANY MIDLAND, MICH.	TE 2-2311	JUPITER			INSULATORS FOR TAIL SECTION			
		ATLAS		E	L & O SOLID PROPELLANTS COMPUTER & CONTROL CASES			
THE DOW METAL PROD. CO. DIV. OF DOW CHEMICAL MIDLAND, MICH.	ME6-1000	NIKE	BAY CITY PLANT 801 ANDRE ST. BAY CITY, MICH.	TW3-7501	MISSILE COMPONENTS / RADAR COMP	H.CHAMBERLAIN	H.ELLIOTT	R.SCHWERIN
		NIKE			CABINETRY	SAME	C.LEMNHARDT	R.SCHWERIN
		HAWK			EQUIPMENT SUPPORTS	SAME	SAME	SAME
		TITAN			CONTAINERS	SAME	SAME	SAME
		ATLAS			SUPPORT FRAMES	SAME	SAME	SAME
		GOMARC			GUIDANCE CONTAINERS	SAME	SAME	SAME
DRESSER-IDECO CO. 875 MICHIGAN AVE. COLUMBUS 8, OHIO	AX9-2123	GOMARC	"	D	LAUNCHER SHELTERS	B.CRESSMAN	G.WOODWARD	L.WILDENMUTH
		GOMARC	"	C	ANTENNA STRUCTURES	O.PELKEY	SAME	SAME
		NIKE HERCULES	"	C	ANTENNA TOWERS	SAME	SAME	SAME
DRYOMATIC CORPORATION 806 N. FAIRFAX ST., BOX 334 ALEXANDRIA, VA.	KI9-3060	ATLAS	"	A	DEHUMIDIFIERS	T.HUTCHINSON	C.WELLS	A.HASS
		NIKE-HERCULES	"	B	SAME	A.HASS	SAME	L.DALLEY
		JUPITER	"	B	SAME	T.HUTCHINSON	SAME	SAME
				A	SAME	A.HASS	SAME	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
DUNHAM-BUSH INC. 179 SOUTH ST. W. HARTFORD CONN. CH 9-8671	HAWK	"	A	HEAT EXCHANGERS	E.CARELL	J.BYSTROWSKI	T.LOGAN
	"	"	B	COOLING PACKAGES	SAME	SAME	SAME
DUNLAP AND ASSOCIATES, INC. 420 ATLANTIC STREET STAMFORD, CONN. FI 8-9271	POLARIS	"	D	SYSTEMS ANALYSIS, ENGINEERING	M. TOLCOTT		
	TALOS	"	A	HUMAN ENGINEERING	K. YARNOLD		
	HAWK	"	C	HUMAN ENGINEERING & SYSTEMS	M. TOLCOTT		
	SPARROW	"	B	SAME	SAME		
	SWALLOW	"	A	HUMAN ENGINEERING	J. ORLANSKY		
	NIKE-ZEUS	"		TRAINING EQUIPMENT	SAME		
	HAWK	"	A	HUMAN ENGINEERING & SYSTEMS	M. TOLCOTT		
	EAGLE	SANTA MONICA, CALIF. EX 3-0166	A	HUMAN ENGINEERING	J. BULFECK		
	SHILLELAGH	SAME	A	PERSONNEL SUB-SYSTEM ANALYSIS	SAME		
	TARTAR	"	A	PERSONNEL REQUIREMENTS	K. YARNOLD		
	ANIP	"	B	HUMAN ENGINEERING	J. ORLANSKY		
	PMR	"	B	SYSTEMS & HUMAN ENGINEERING	K. YARNOLD		
DURANT MFG. CO. 1929 W. OKLAHOMA AVE. MILWAUKEE 15, WIS.		"		DIGITAL COUNTERS FOR: NIKE, MATADOR, SNARK, JUPITER, THOR, HAWK, POLARIS, REGULUS, SUBROC, RASCAL, ATLAS, TITAN, NIKE, PERSHING, LACROSSE			
DYNAMIC AIR ENGR. INC. 7412 MAIE AVE. LOS ANGELES 1 CAL. LU8-3292		"	C	FANS AND BLOWERS	R.FEHRING	O.MAXWELL	A.BROWN
DYNAMIC CONTROLS CO. 1955 MASSACHUSETTS AVE. CAMBRIDGE 40, MASS. EL4-3633	HAWK	"	B	POWER SUPPLIES	B.O'SULLIVAN		

E

EAGLE-PITCHER CO. AMERICAN BLDG. CINCINNATI 1, OHIO. PA 1-7010	LACROSSE	"		BATTERY			
	JUPITER	"		SAME			
EASTMAN KODAK CO. 333 STATE STREET ROCHESTER 4, N. Y. LO 2-6000	SIDEWINDER	"		FUSE			
	TERRIER A	"					
	SENTRY	"					
	DOVE	"		ROCKET ENGINE & GUIDANCE			
EDGERTON, GERMESHAUSEN & GRIER 160 BROOKLINE AVE. BOSTON 15, MASS. CO7-9700	ROVER	"	E	INSTRUMENTATION	B.BRETTLER	D.MCCLELLAN	F.MAHONEY
	MINUTEMAN	"	C	INSTRUMENTATION	E.COLSON	D.MCCLELLAN	F.MAHONEY
	NACE	"	B	INSTRUMENTATION	E.COLSON	D.MCCLELLAN	F.MAHONEY
ETCAL MANUFACTURING CO., INC. ALBUQUERQUE, NEW MEXICO CH2-5223	HAWK	"	E	TRAILERS	S.GOODIN	H.PEDERSON	W.HUFF
THE ELECTRIC HOTPACK CO., INC. COTTMAN AND MELROSE STS. PHILA. 35, PA. DE3-1700		"		TEST CHAMBERS	S.LARSENSON	W.DITZLER	W.HUNSBERGER
ELASTIC STOP NUT CORP OF AMERICA UNION, N. J. MU 6-6000	JUPITER	"		SPECIAL PURPOSE FASTENERS			
ELECTRO-MECHANICAL RESEARCH INC. P.O. BOX 3041 SARASOTA, FLA. RI 6-1146	JUPITER	"		REDUCTION EQUIP.			
	POLARIS	"		SAME			
	ATLAS	"		AIRBORNE TELEMETER			
	THOR	"		REDUCTION EQUIP.			
	TITAN	"		AIRBORNE TELEMETER			
	MERCURY	"		TELEMETRY SYSTEM			
ELECTRO-MINIATURES CORP. 600 HUYLER ST. S. HACKENSACK, N.J. HU9-7770	HAWK	"		SLIP RING ASS'Y (LAUNCHER)	J.RECTOR	V.DE LONGIS	L.LOPEZ
	SUBROC	"		ROTARY SWITCH (GUIDANCE)	J.RECTOR	V.DE LONGIS	L.LOPEZ
ELECTRONIC TUBE CORP. 1200 E. MERMAID LANE PHILA. 18, PA. CH7-6800	HACE	"	C	CHECKOUT EQUIPMENT	R.RUHE	R.MILLER	A.HOLMES
	BULLPUP	"	A	CHECKOUT EQUIPMENT	R.RUDE	R.MILLER	A.HOLMES
ELECTRONICS DEVELOPMENT CO., INC. 3743 CAHUENGA BLVD. N. HOLLYWOOD, CALIF. TR 7-3223			E	DATA TELEVISION TRANSMISSION	J. LEAMING	J. LEAMING	J. ANGELO
ENGINEERED PRECISION CASTING CO.							

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000 C—$100,000—$500,000 E—$1 —$10 million G—$25—$50 million I—$75 —$100 million K—Over $250 million
B—$50,000—$100,000 D—$500,000—$1 million F—$10—$25 million H—$50—$75 million J—$100—$250 million

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
ELECTRO-PULSE INC. 11861 TEALE ST. CULVER CITY, CALIF. UPO-9193	NIKE ZEUS	"	A	GROUND SUPPORT ELECTRONICS	J.JOHNSON	B.KULLAR	S.GREEN
	BOMARC	"	A	SAME	SAME	SAME	SAME
	117L	"	B	SAME	SAME	SAME	SAME
	65	"	A	SAME	SAME	SAME	SAME
	VANGUARD	"	C	SAME	SAME	SAME	SAME
	SHERS	"	B	SAME	SAME	SAME	SAME
ELECTRO TEC CORP. 10 ROMANELLI AVE. S. HACKENSACK N.J. HU 7-4940	TARTAR	FLORIDA DIV. BOX 667 ORMOND BEACH, FLA. OR7-1771	E	RADAR SLIP RINGS	P.FILIPCZAK	W.BAUBAKER	C.FLOWERS
	TITAN	SAME	D	RELAYS, SWITCHES	H.GROSS	SAME	SAME
	NIKE-ZEUS	VIRGINIA DIV. BOX 219 BLACKSBURG, VA. PR2-6208	D	SLIP RINGS	J.CARPENTER	C.LISKEY	C.BOWLING
	HERCULES	SAME	D	SAME	SAME	SAME	SAME
	HAWK	FLORIDA AND SOUTH HACKENSACK DIV.	C	RADAR SLIP RINGS	P.FILIPCZAK	H.FRANK	G.PARIGORIS
ELGIN NATIONAL WATCH COMPANY 107 NATIONAL STREET, ELGIN, ILLINOIS. SH 2-3300	BULLPUP			FUSE			
	SIDEWINDER			SAME			
	SPARROW II	ELGIN MICRO-WEST CST. DIV. 21001 NORDHOFF ST. CHATSWORTH, CAL. DI 0-7220		SAFETY & ARMING SAME			
	TERRIER II	SAME		SAME			
	TARTAR	SAME		SAME			
	JUPITER	"		RELAYS			
ELLIOTT ENGR. CO., INC. 2403 E. CENTURY BLVD. LYNWOOD, CALIF. NE6-0231	HOUND DOG	PRECISION CABLED PROD DIV. 734 LAWRENCE ST. LOS ANGELES, CALIF.	C	MISSILE ELECTRONIC CABLE	E.EYLER	H.ADAMS	A.JUDKINS
	TITAN	"	C	WELDING & MACHINED PARTS	C.ROBINSON	H.MOORE	A.JUDKINS
	ATLAS	"	C	MACHINED PARTS, WELDING	C.ROBINSON	H.MOORE	A.JUDKINS
	MINUTEMAN	"	C	MACHINED PARTS	SAME	SAME	SAME
	CORPORAL	"	C	MACHINED PARTS	SAME	SAME	SAME
EL-TRONICS, INC. SUBURBAN STATION BLDG. PHILA., PA. LO8-2650		AL-AC COMPUTER DIV. 13040 S. CERISE AVE. HAWTHORNE, CALIF. ORB-5774	C	DIGITAL COMPUTER	R.HASS	R.MULLINS	A.PENA
THE EMERSON ELECTRIC MFG. CO. 8100 FLORISSANT AVE. ST. LOUIS 36, MO. CO1-1800	HONEST JOHN	"	E	AIRFRAME	W.DROEGE	J.FREY	J.ALLES
	IMPROVED HONEST	"	E	MOTOR CASES	B.BURRIS	J.FREY	J.ALLES
	LITTLE JOHN	"	E	AIRFRAME	O.BROWN	J.FREY	J.ALLES
	MISSILE A	"	B	BOOSTER MOTORS	W.BRYANT	H.SHAW	J.ALLES
	LITTLEJOE	"		CAPSULE HEATING PROTECTION	R.FELDMAN		J.ALLES
EMPIRE DEVICES PROD. CORP. 37 PROSPECT STREET AMSTERDAM, NEW YORK VI 2-8400		"	D	RADIO INTERFERENCE MEASUREMENT	W.LAMBDIN	J.OLSZOWKA	A.COHEN
		"	C	MICROWAVE COMPONENTS	W.LAMBDIN	J.OLSZOWKA	A.COHEN
EMPIRE ELECTRONICS CO., INC. 60 SPRUCE STREET PATERSON 1, N.J. AR 4-8282			C	CABLE & CORD ASSEMBLIES	G.SURASKY	G.F.MODUSINO	W.SURASKY
ENGINEERING & MFG. CO., INC. 611 NORTH 40TH STREET PHILADELPHIA 4, PENNA. EV 6-8757	NIKE	"	C	GROUND SUPPORT	L.SHELDON	R.MATTOX	R.MATTOX
ESPEY MFG. CO., INC. P. O. BOX 422 SARATOGA SPRINGS, N.Y.	HAWK	BOX 422 SARATOGA SPRINGS, N.Y.	D	MAGNETIC COMPONENTS	D. CAVENAUGH	J. CANTERINO	J. ZAMUR
ERA ENG. INC. 1004 MONTANA AVE. SANTA MONICA, CALIF. EX 5-9995	POLARIS	"	A	ACCELERATION SWITCHES	W. GREGGE	H. HUTCHINSON	H. CRAMER
	PERSHING	"	A	SAME	SAME	SAME	SAME
EUBANKS INDUSTRIES, INC. HIALEAH, FLA. OX 1-7552		"	A		S.EUBANKS	E.CAMEN	E.CAMEN
	LACROSSE	"	A	MOTOR GENERATOR CARRYING CASE	W.CORD	SAME	SAME
	LACROSSE	"	A	AIMER CARRIER CASE	SAME	SAME	SAME
	LACROSSE	"	A	ELECTRONIC SUPPORT BRACKETS	SAME	SAME	SAME
	NIKE-ZEUS	"	A	ELECTRONIC INSTRUMENT PANELS	S.EUBANKS	SAME	S.EUBANKS
			A	ANTENNA COVER	SAME	SAME	SAME
EXACT ENGINEERING & MFG., INC.	POLARIS	"		SERVO COMPONENTS	B.POWERS	F.PENDLETON	O.PAIGET
EUGENE ENGINEERING CO., INC. 1217 HYDE PARK AVE. OCEANSIDE, CALIF. SA 2-2144 BOSTON 36, MASS. HY 3-4404	HAWK	"	C	ELECTRONIC SHEET METAL	D.GARDNER	J.EIFLER	T.HANNON
	SPARROW	"	C	SAME	SAME	SAME	SAME
	NIKE ZEUS	"	C	SAME	SAME	SAME	SAME
	NIKE HERCULES	"	C	SAME	SAME	SAME	SAME
	TALOS	"	C	SAME	SAME	SAME	SAME
	ATLAS	"	C	SAME	SAME	SAME	SAME
EXCELLEX ELECTRONICS, INC. 39-51 60TH STREET WOODSIDE 77, N.Y. OL 1-3390		"	C	TERMINAL BOARDS	H. TACKEL	H. WEINSTEIN	H. WEINSTEIN

*Code for Approximate Contract Dollar Value

A—$10,000—$ 60,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)		$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
					F			
FAE INSTRUMENT CORP. 42-61 HUNTER STREET LONG ISLAND CITY 1, N.Y. ST 6-4959				C	ELECTRONIC COMPONENTS	A.ONYSKIW	E.AMPINO	A.MANKES
	HAWK			C	SAME	SAME	SAME	SAME
FAIRBANKS-MORSE & COMPANY 600 S. MICHIGAN AVE. CHICAGO 5, ILL. HA 7-7100	JUPITER	"			FUELING EQUIP.			
	REDSTONE	"			DIESEL ENG. GENERATORS			
FAIRCHILD CAMERA & INSTRUMENT CORP ROBBINS LANE LONG ISLAND, N.Y. WE 1-4500	JUPITER	"		C	ORDNANCE DEVICES			
	LITTLEJOHN	"		C	SAME			
FAIRCHILD CONTROLS CORP. 225 PAR AVENUE HICKSVILLE, NEW YORK	REDSTONE	COMPONENTS DIV. 235 PARK AVENUE HICKSVILLE, N.Y.			RATE GYROS	M. LEVITT	R. ANGUST	P. CROCKETT
	PROJ. MERCURY	SAME			PRESSURE TRANSDUCER	R. GITLIN	SAME	SAME
	ATLAS	SAME			SAME	SAME	SAME	SAME
	SATURN	SAME			SAME	SAME	SAME	SAME
	POLARIS	SAME			SAME	SAME	SAME	SAME
	THOR	SAME			POTENTROMPTENS	SAME	SAME	SAME
FAIRCHILD ENGINE AND AIRPLANE CORP HAGERSTOWN 10, MD. PE 3-3600		FAIRCHILD ACFFT. MISSILE DIVISION		E	SURVEILLANCE SYSTEM	T.HORRELL	J.RHODES	S.MULRONEY
FAIRFIELD ENGINEERING CORP. 114 MANHATTAN STREET SPRINGDALE, CONN. DA 5-1561		"		E	MAGNETIC RETIFIER CONTROLS	F.HACKLEM	H.FRANKEL	H.FRANKEL
FARNSWORTH ELECTRONICS 3700 E. PONTIAC ST. FORT WAYNE, IND. EA 7571	TALOS	"			GUIDANCE			
	BOMARC	"			HANDLING & SERVICE EQUIP.			
FEDERAL ELECTRIC CORPORATION 621-671 INDUSTRIAL PARK PARAMUS, NEW JERSEY CO 1-7200		"		F	TECHNICAL SERVICES MAINTENANCE & OPERATIONS			
FEDERAL SCIENTIFIC CORP. 615 EAST 131ST STREET NEW YORK 37, N.Y. AU 6-4400		"		C	SIGNAL ENHANCERS	H.BICKEL		H.WIENER
FEEDBACK CONTROLS, INC. 8 ERIE DRIVE NATICK, MASS. OL 3-3481		"		D	COMPUTERS	R. QUICK	J. BERNIER	S. BLACK
FIRESTONE TIRE & RUBBER CO. AKRON, OHIO	CORPORAL	GUIDED MISSILE DIV. LO SAME ALIF.	LU 3-4811	F	MISSILE COMPONENTS & GROUND HANDLING EQUIP.	D.T.SIGLEY	F.R.KUNTZ	M.H.PETERSON
THE FIREWEL COMPANY, INC. 3695 BROADWAY BUFFALO 2, NEW YORK RE-0440	MERCURY	"		A	REGULATOR	R.CUMMINS	E.KNAPP	R.SALTZMAN
FLEXCO, INC. 7946 SALT LAKE AVE. HUNTINGTON PARK, CALIF. LU 3-1504	ATLAS	"		A	DUCTS, STRUCTURAL COMPONENTS	R.HICKMAN	M.SHARP	C.SLAGLE
FLEXONICS CORPORATION 1352 S. THIRD AVE. MAYWOOD, ILL. FI 3-8000	SATURN	AERONAUTICAL DIV. ELGIN, ILL. ELGIN, ILL.	SH 2-7800	D	ROCKETS AND LAUNCHERS	E.LANZ	R.EKHOLM	W.FREE
	THOR			C	ROCKETS	SAME	SAME	SAME
	THOR	SANTA ANA, CALIF.	KI 5-8261	B	ROCKETS	L.FEISLER	K.KAMPENGA	H.BAKER
	ATLAS			C	ROCKETS	SAME	SAME	SAME
	TITAN	ELGIN, ILL.	SH 2-7800	A	ROCKETS	E.LANZ	R.EKHOLM	W.FREE
	CENTAUR			A	ROCKETS	SAME	SAME	SAME
FLIGHT SCIENCES LAB., INC. 1965 SHERIDAN DRIVE BUFFALO 23, N.Y. VI 7166		"		C	AERODYNAMICS & AEROPHYSICS RESEARCH	J.ISENBERG		
FOOD MACH. & CHEM. CORP. COLEMAN AVENUE SAN JOSE, CALIF. CY 4-8124	HAWK	"			LOADER			
	NIKE SYSTEM BOMARC	" RECCO CHEMICAL DIV. P.O. STA. B BUFFALO 7, N. Y.	BE 8300		SHIPPING CONTAINERS LAUNCH ERECTORS & POWER PACK			
	MINUTEMAN THOR	SAME SAME			GROUND HANDLING TRANSPORTER, LAUNCHER			
FORMSPRAG COMPANY WARREN, MICH. JE 6-9000	LITTLE JOHN	"		B	OVERRUNNING CLUTCHES	CANUELLA	ZAREMSA	W.T.CHERRY
	RASCAL	"		E	SAME		SAME	
FOTO-VIDEO LABORATORIES, INC. 36 COMMERCE ROAD CEDAR GROVE, N.J. CE 9-8100		"		C	ELECTRONIC COMPONENTS	A. BAPACKET	H. AMMANN	W. HUMS
		"						
		"						

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
FRANKLIN FIBRE-LAMITEX CORP. 129 LAFAYETTE STREET NEW YORK 13, N.Y. CA 6-4376	THOR	18TH & MARKET STS. WILMINGTON, DEL. OL 8-5269	A	GUIDANCE - EPOXY MACHINED PART	J.VACHRIS	H.FINGER	ROBERTS
	NIKE-ZEUS		A	TERMINAL BOARD MACHINES	SAME	SAME	SAME
FRUEHAUF TRAILER CO. 10940 HARPER AVENUE DETROIT 32, MICH. VA 1-2410	JUPITER	MISSILE PROD. DIV. 5127 S. BOYLE LOS ANGELES 58, CALIF.	C	FUELING EQUIP.			
	NIKE-HERCULES	SAME		TRANSPORT VEHICLES			
	REDSTONE	SAME		FUELING EQUIP.			
	POLARIS	SAME		GROUND HANDLING			
	REGULUS	SAME		HANDLING & SERVICE EQUIP.			
	THOR	SAME		GROUND HANDLING			
	TITAN	SAME		SAME			
	ATLAS	SAME		SAME			
	GENIE	SAME		ANTENNAS & CARRIERS			
	HAWK	SAME		SAME			
THE FULTON-SYLPHON CORPORATION P.O. BOX 591 DOVER, N.H. FO 6-7474	ATLAS	#	A	CARTRIDGE ACTUATED VALVES	J.BLACK	A.SCHELLMAN	J.BYRNE

G

GABB SPECIAL PRODUCTS, INC. WINDSOR LOCKS, CONN. NA 3-4414		#	D				
THE GABRIEL COMPANY 15430 AVALON BLVD. COMPTON, CALIF. FA 1-4200	PHOENIX	ROCKET POWER DIV. FALCON FIELD MESA, ARIZ. SAME 60 6-1711	A	SOUNDING ROCKET-2ND STAGE	D.SHONERD	W.HALLAS	J.DAVIS
	HOUND DOG	TALCO ENG. DIV. FALCON FIELD MESA, ARIZ. 60 6-1711	C	MISSILE RELEASE UNIT	S.DANYOW	J.SCHROEDER	J.BURGER
	CORVUS	SAME	C	RECOVERY SYSTEM	R.STRICKLAND		
	POLARIS	SAME	C	SAFE-ARM UNITS	S.DANYOW		
		GABRIEL ELECTRONICS DIV 1149 EUCLID AVENUE CLEVELAND 15, OHIO	D	COMMAND DESTRUCT	E. PROHASKA	J. HALL	C. NOLAN
		SAME	D	MISSILE TRACKING	SAME	SAME	SAME
		SAME	C	COMMAND CONTROL	J. BUCKLEY	SAME	SAME
	HOUND DOG	ROCK POWER/TALCO FALCON FIELD MESA, ARIZ. 60 6-1711	C	MISSILE RELEASE	D. SHONERD	S. DANYOW	J. BURGER
	CORVUS	SAME	S	RECOVERY SYSTEM	SAME	SAME	SAME
	PHOENIX	SAME	A	COMPLETE	SAME	SAME	SAME
	GENIE	SAME	C	BALLISTIC SWITCH	SAME	SAME	SAME
	POLARIS	SAME	A	SAFEARM	SAME	SAME	SAME
	ATLAS	SAME	A	SEPARATION CNTR	SAME	SAME	SAME
	NIKE	SAME	A	DELAY SWITCH	SAME	SAME	SAME
	MACE	SAME	A	CUTTERS	SAME	SAME	SAME
	AN/USD-2(EAE-2)	SAME	A	ROCKET MOTORS	SAME	SAME	SAME
GAMAH CORPORATION 1691 LINCOLN BLVD. SANTA MONICA, CALIF. EX 3-0401		#	C	TUBE COUPLINGS	L.RICE	H.HILLIER	H.HILLIER
GAR MFG. CORP. 73 PARK STREET BEVERLY, MASS. WA 2-1626	HOMARC	#	A	METAL PARTS	J.BATES		A.D.STONE
	ATLAS	#	A	SAME	J.BATES		A.D.STONE
	HAWK	#	A	SAME	J.BATES		A.D.STONE
THE GARLOCK PACKING CO. 402 MAIN STREET PALMYRA, NEW YORK LY 7-4811	MINUTEMAN	#	C	CHAMBER INSULATION	S. ONDERKO	G. WILDRIDGE	A. TRAUTMAN
	POLARIS	#	C	CHAMBER INSULATION	S. ONDERKO	G. WILDRIDGE	A. TRAUTMAN
THE GARRETT CORPORATION 9851 SEPULVEDA BLVD. LOS ANGELES 45, CALIF. SP 6-1010	NIKE-HERCULES	AIRESEARCH MFG. DIV. 9851 SEPULVEDA BLVD. LOS ANGELES, CALIF. SP 6-1010		AUXILIARY POWER UNIT			
	NIKE-ZEUS	SAME		AUXILIARY POWER UNIT			
	SHARP	SAME		AUXILIARY POWER STEERING			
	POLARIS	SAME		SPIN GENERATOR, SAFE-ARM ACT			
	PERSHING	SAME		PRESSURE REGULATOR			
	HOUND DOG	SAME		HEAT EXCHANGERS AND VALVES			
	MERCURY	SAME		ENVIRONMENTAL CONTROL SYSTEM			
	SWALLOW	SAME		AIR CONDITIONING SYSTEM			
	POLARIS	AIRESEARCH IND. DIV. LOS ANGELES, CALIF. OR 8-7861		AIR REGULATOR, BREATHE UNIT			
	ATLAS	SAME		HIGH PRESSURE NITROGEN REG			
	JUPITER	SAME		FUELING SYSTEM CHECK VALVE			
	ATLAS	AIRESEARCH-PHOENIX PHOENIX, ARIZ. OR 8-6311	E	FILL AND DRAIN SYSTEMS, VALVES	R.DUNNAWAY	R.HILBERT	C.DOPELL
	TITAN		D	SAME	SAME	SAME	SAME
	SERGEANT		E	GAS TURBINE GENERATORS	C.PAUL		H.PAYNE
	HOUND DOG	SAME	C	PROBE STARTERS	D.GETZ		H.PAYNE
	GREEN QUAIL	SAME	D	AIR TURBINE GENERATORS			
	NIKE-ZEUS	#		SOLID PROPELLANT-ACCESSORIES			
GATES ELECTRON CO. BRONX 60, NEW YORK TY 2-6490		#	A	U C POWER SUPPLIES	S.LANDER	J.REGEN	J.PHILLIPS

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
GENERAL ELECTRIC CO. 570 LEXINGTON AVE. NEW YORK, N.Y. PL 1-1311	ATLAS	MI SAME E VEH. DEPT. 3198 CHESTNUT ST. PHILADELPHIA, PA. EV 2-7800		RE-ENTRY VEHICLE	L.COWLES	W.KINSEY	J.BENZIF
	THOR	SAME		SAME	SAME	SAME	SAME
	THOR-ABLE	SAME		SAME	SAME	SAME	SAME
	DISCOVERER	SAME		SAME	SAME	SAME	SAME
	STEER	SAME		COMMUNICATION SATELLITE	SAME	SAME	SAME
	NERV			RE-ENTRY VEHICLE	SAME	SAME	SAME
	ALBM	SAME		SAME	SAME	SAME	SAME
	LITTLE JOHN	SAME		ARMING & FUZING	SAME	SAME	SAME
	CENTAUR	ACFT. ACC. TUR. DEPT. 950 WESTERN AVE. WEST LYNN, MASS. LY 8-6000		MONOPROP-TURBODRIVE	F.ELLENBERGER	C.LURON	W.COLTES
	NUCLEAR ENGINE	SAME		TURBOSTARTER	W.ANTRIM	J.CLARKE	SAME
	POLARIS			HYD. PUMP	T.COPPINGER	C.LAMON	SAME
	ATLAS	DEFENSE SYS. DEPT. 300 S. GEDDES ST. SYRACUSE, N.Y. GR 6-4411	K	GUIDANCE & TRACKING SYS.	N.SHIMAT	D.JOHNSON	R.BECKER
	POLARIS	ORDNANCE DEPT. 100 PLASTICS AVE. PITTSFIELD, MASS.	I	FIRE CONTROL	R.QUALLEN	M.SASSO	H.KIMOL
	POLARIS	SAME	I	INERTIAL GUIDANCE	D.BATES	D.BENNETT	G.FRY
	TALOS	SAME	F	HANDLING & LAUNCHING EQUIP.	B.KIMBALL	W.SAFFORD	C.GORDIN
	TARTAR	SAME	F	FIRE CONTROL	H.SIDES	F.OTTO	H.FAHNAM
	ATLAS	SAME	F	TRACKING ANTENNA	A.HERSH	G.KIZER	E.HALPIN
	CROSSPOW	D.C. CURRENT MOTOR GENERATOR DEPT. ERIE, PA.		POWER SUPPLY			
	RASCAL	SAME		SAME			
	ATLAS	SAME		SAME			
	SIDEWINDER	SAME		SAME			
	LA CROSSE	GEN. ELE. CO. LAKESIDE AVE. BURLINGTON, VT. JN 3-3411	E	SAFING, ARMING AND FUZING	O. REINER	C. STANKEVICH	G. CURRY
	THOR	SAME	E	RE-ENTRY VEHICLES	T. STANZIOLA	E. FARRINGTON	
		REC. TUBE DEPT. 316 E. 9TH ST. OWENSBORO, KY MU 3-2401	C	MODULAR CERAMIC CIRCUITS	A. HOASE	K. JEVALT	S. BILOK
		CATHODE RAY TUBE ELECTRONICS PARK SYRACUSE, N.Y.		CATHODE RAY TUBES			
GENERAL ELECTRODYNAMICS CORP. 4853 FOREST LANE GARLAND, TEXAS BR 6-1161		"	C	ELECTRONIC TUBES	H. ALBERTINE	H. ALBERTINE	W. LAWSON
			"				
GENERAL METALS CORP. 10777 VAN OAEN BLVD. BURBANK, CALIF. TR 7-2611	TARTAR	ADEL DIV.	D	HYDRAULIC POWER SUPPLY	W.DRUMMY	W.YUSS	A.HAINES
	SERGEANT	SAME	D	HYDRAULIC POWER UNIT	SAME	SAME	SAME
	SPARROW III	SAME	E	SAME	SAME	SAME	SAME
	TITAN	SAME	D	HYDRAULIC VALVES	SAME	SAME	SAME
	REDSTONE	SAME	A	HYDRAULIC VALVES	SAME	SAME	SAME
GENERAL MILLS, INC. 1620 CENTRAL AVE. MINNEAPOLIS, MINN. ST 9-8811	MACE	MECHANICAL DIV. 1620 CENTRAL AVE. MINNEAPOLIS, MINN. ST 9-8811		GUIDANCE			
	JUPITER	SAME		GROUND SUPPORT			
	DEFENDER	SAME		RESEARCH			
GENERAL MOTORS CORP. GENERAL MOTORS BLDG. DETROIT 2, MICH. TR 3-7200		AC SPARK PLUG DIV. 1300 W. DORT RD. FLINT 2, MICH. CE 8-5611		GUIDANCE SYSTEMS, GYROSCOPES			
		DIESEL EQUP. DIV. 2100 BURLINGAME AVE. GRAND RAPIDS, MICH. CH 5-0481		FUEL NOZZLES	C. DOWLEY	A. KROTE	V. LUMLEY
	MINUTEMAN	ALLISON DIV. INDIANAPOLIS, IND. CH 4-1511		1ST AND 2ND STAGE MOTOR CASES	W. BROFFITT	R. SETTLE	R. SPORUS
		NEW DEPARTURE DIV. 269 N. MAIN STREET BRISTOL, CONN. LU 2-6371		INST., BEARINGS FOR REDSTONE, POLARIS, TITAN, THOR, MACE, JUPITER, PERSHING, MERCURY.			
		SANDUSKY DIV. HAYES AVENUE SANDUSKY, OHIO MA 6-2120		INST. BEARINGS FOR BULLPUP, SIDEWINDER, BOMARC, NIKE.	P. WALLACK	F. HIMMELEIN	W. RYAN
GENERAL PRECISION EQUIP. CORP. 92 GOLD ST. NEW YORK 38, N.Y. BE 3-4170	ATLAS	KEARFOTT DIV. GENERAL PRE., INC. LITTLE FALLS, N.J. CL 6-4000		GYROS, SERVOS, TEST EQUIPMENT			
	SUBROC	SAME		GUIDANCE AND SERVO COMPONENTS			
	BOMARC-B	SAME		GUIDANCE AND SERVO COMPONENTS			
	POLARIS	SAME		GYROS ACCELEROMETERS, SERVOS			
	PERSHING	SAME		GYROS-CONTROLS & SERVOS			
	JUPITER	SAME		SERVOS			
	JUNO	SAME		SERVOS			
	MERCURY	SAME		SERVOS			
	THOR	SAME		SERVOS			
	CORVUS	SAME		GYROS AND SERVOS			
	TALOS	SAME		GYROS			
	MACE	SAME		GYROS AND SERVOS			
	CORPORAL	SAME		SERVOS			
	HAWK	SAME		SERVOS			
	LACROSS	SAME		SERVOS			
	MINUTEMAN	SAME		SERVOS			
	TITAN	SAME		SERVOS			
GILMORE INDUSTRIES, INC. 13015 WOODLAND AVE. CLEVELAND, OHIO RA 1-6400	ATLAS	"	C	MEASUREMENT & CALIBRATION EQUIP	R.CARLETON	G.DIGERONIMO	M.NAGER
	POLARIS	"	A	SAME	SAME	SAME	SAME
	JUPITER	"	B	SAME	SAME	SAME	SAME
	MINUTEMAN	"	B	SAME	SAME	SAME	SAME
	BOMARC	"	B	RAMJET TEST INSTRUMENTATION	SAME	SAME	SAME
	THOR	"	B	MEASUREMENT & CALIBRATION	SAME	SAME	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
GLADDING, MCBEAN & CO. LOS ANGELES 39, CALIF. NO 3-3361	SPARROW III	a	B	CERAMIC RADOMES	L.LECLERCQ	F.ARRANCE	W.MOON
GLASSCO INSTRUMENT CO. 777 S. ARROYO PARKWAY PASADENA, CALIF. MU 1-4637		BOURDON-HELIX DIV. 777 So. ARROYO PKWY. PA SAME Fa MU 1-4637	C	PRESSURE GAUGES AND SWITCHES	C. MAZOJCH	G. NORTHROP	G. NORTHROP
GOOD ELECTRONIC CORP. P.O. BOX 2406 PALM BEACH, FLA. VI 8-3241		a	A	STABILIZED AMPLIFIERS	L.GOOD	C.DAVIES	E.MATHES
GOODRICH-HIGH VOLTAGE ASTRO BURLINGTON, MASS.	ABMA	1	B	ION PROPULSION	A.GALE	G.BULWINKLE	R.CHASE
GOODYEAR AIRCRAFT CORP. 1210 MASSILLON ROAD AKRON 15, OHIO RE 3-6361	HAWK	a		RADAR COMPONENTS			
	JUPITER	a		NOSE CONE			
	NIKE-HERCULES	b		BOOSTERS & SOLID SUSTAINER			
	NIKE-ZEUS	a		SAME			
	SUBROC	a					
	ATLAS	a		HANDLING & SERVICE EQUIP. VEH			
	DYNA-SOAR	a		GUIDANCE SYSTEM MANAGEMENT			
	HACE	a		GUIDANCE, GROUND SUPPORT EQUIP			
	MATADOR	a		SAME			
GRAHM TRAILER CORP. 429 E. O'CONNOR LIMA, OHIO CA 9-7015	THOR	a		POWER TRAILERS	G. P. MILLER	C. SMITH	V. S. BUCHANAN
	NIKE	b		ELECTRONIC VANS	SAME	SAME	SAME
	JUPITER	a		GROUND SUPPORT EQUIPMENT	SAME	SAME	SAME
	BOMARC	a		LOADING EQUIPMENT	SAME	SAME	SAME
GRAND CENTRAL ROCKET CO. P.O. BOX 111 REDLANDS, CALIF. PY 3-3593	NIKE-ZEUS	a		SUSTAINER ROCKET MOTOR	R.PIERCE	J.ROSSI	J.EDWARDS
	MERCURY	a		ESCAPE ROCKET MOTOR	R.BOEHTEL	SAME	SAME
	TITAN	a		STAGE SEPARATION ROCKET MOTOR	A.CHAVEZ	SAME	SAME*
	WOLF	a		TERMINAL STAGE ROCKET MOTOR	C.JURAN	SAME	SAME
THE GRAY MFG. CO. 16 ARBOR STREET HARTFORD 1, CONN. AD 3-1271		a	E	ELECTRONIC & MECHANICAL COMP	G.RAYMOND	W.DESCAULT	R.WAHATALO
GREER HYDRAULICS, INC. N.Y. INTERNATIONAL APT. JAMAICA 30, N.Y. OL 9-9700	BOMARC		B	GROUND SUPPORT	H.POLANSKI	S.POLANSKI	W.WALSH
	TITAN		C	COMPONENTS			
	TALOS		C	COMPONENTS			
GREAT LAKES MFG. CORP. 4223 MONTICELLO BLVD. CLEVELAND 21, OHIO EV 2-5500		b	E	PUMPS, COMPRESSORS, SWITCHES	J. COMPTON	L. MATTHEWS	R. SPANSON
GREMAR MFG. CO., INC. 7 NORTH AVENUE BAKERFIELD, MASS. CR 9-4580		a	C	CO-AXIAL CABLE CONNECTORS	S. SOMERSET	G. STAPLES	E. MCCORMICK
GRIMSON COLOR, INC. 381 PARK AVENUE SOUTH NEW YORK 16, N.Y. OR 9-9088		461 COUNTY BLVD. INGOOD, L.I., N.Y.	C	CLOSED CIRCUIT TELEVISION	CHAS. D. BRYANT		
				ELECTRONIC MEASURING DEVICE	SAME		
GROVE VALVE & REGULATOR CO. 6529 HOLLIS ST. OAKLAND, CALIF. OL 5-7700		a	E	PRESSURE REGULATORS	F.RICHARDS	E.MANN	L.WEST
GUNNAR LABORATORIES 3003 26TH ST. W. BRADENTON, FLA. 5-2751	NIKE AJAX	a		ELECTRIC AND ELECTRONIC PARTS			
	NIKE HERCULES	a	A	SAME			
THE GYREX CORPORATION 3003 PENNSYLVANIA AVENUE SANTA MONICA, CALIF. EX 3-0462	SNARK	b	C	FREQUENCY STANDARDS	W. HOLT	R. BARTSCHI	W. UNDERWOOD
	POLARIS	a	A				
	ATLAS	a		SAME	R. HANSON	SAME	SAME
				SAME	SAME	SAME	SAME
HAGO ENGINEERING CO. HUNTINGTON PARK, CALIF. LU 2-8521		a	D	GROUND SUPPORT ELECTRONICS	A. FRIEDHOLD		L. LAUNER
HALLAMORE ELECTRONICS 8352 BROOKHURST AVE. ANAHEIM, CALIF. PR 4-1010	SNARK	a		RADAR & SURFACE CONTROLS			
	TITAN	a		SAME			
	POLARIS	a		DATA PROCESSING			
	SERGEANT	a		TEST EQUIPMENT			
HAMILTON KENT MFG. CO. 427 GRANT STREET KENT, OHIO OR 3-9555		a	C	VIBRATION MOUNTS	T.ROHE	V.MAZER	O.GREENE
HAMLIN, INC. LAKE AND GROVE STS. LAKE MILLS, WISCONSIN 209	BOMARC	a	B	GUIDANCE COMPONENTS	A.DARSCH	F.LEWIS	R.FERGUSON

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
HANSON LABORATORIES, INC. 374 FAIRFIELD AVENUE STAMFORD, CONNECTICUT DA 5-1391	POLARIS	"	C	SYNTHESIZERS	J.GUTTMAN	A.FAUREAU	T.TOYOTA
HARMAN EQUIPMENT COMPANY 3600 W. OLYMPIC BLVD. LOS ANGELES 23, CALIF.			C	FILTERS	D.PENMAN	J.KELLEY	F.VAN ZANT
			B	PUMPS AND FILTERS	SAME	SAME	SAME
			C	FILTERS	SAME	SAME	SAME
HERCULES POWDER COMPANY 900 MARKET STREET WILMINGTON, DELAWARE	X248MOTOR	ALLEGANY BALLISTICS LAB. CUMBERLAND, MARYLAND RE 8-9000		ROCKET MOTOR	D.WELDER	P.HAWK	T.BROWN
	SCOUT	SAME	F	3RD & 4TH STAGE ROCKET MOTORS	SAME	SAME	SAME
	POLARIS	SAME		2ND STAGE ROCKET MOTOR	N.LEBLANC	SAME	SAME
	TERRIER	SAME		BOOSTER & SUSTAINER ROCKET	D.WELDER	SAME	SAME
	TARTAR	SAME		BOOSTER ROCKET MOTOR	SAME	SAME	SAME
	SNARK	SAME					
	DEACON	SAME		ROCKET MOTOR	D.WELDER	P.HAWK	T.BROWN
	MINUTEMAN	BACCHUS, UTAH MAGNA 6321	F	3RD STAGE ROCKET MOTOR	J.MAIN	W.RUE	G.STAIR
	SKYDART	KENVIL, NEW JERSEY FO 6-5150		ROCKET MOTOR	J.MARX	H.PLUNKETT	
	RADIO PLANE RP-7	SAME		SAME	SAME	SAME	
	NIKE HERCULES	RADFORD, VIRGINIA NE 9-4811		BOOSTER ROCKET MOTOR	E.CARROLL	H.DAVIES	H.DOTO
	HONEST JOHN	SAME		SAME	SAME	SAME	SAME
	LITTLE JOHN	SAME		SAME	SAME	SAME	SAME
THE HERTNER ELECTRIC CO. 12690 ELMWOOD AVENUE CLEVELAND 11, OHIO CL 2-4242	"		D	POWER SUPPLIES	R. ANDERSON	A. FALK	P. GARIEPY
HEXCEL PRODUCTS, INC. 2332 FOURTH STREET BERKELEY 10, CALIF TH 3-4644		EA SAME ON OLD POST ROAD HAVRE DE GRACE, MD.	E	STRUCTURAL HONEYCOMB	J.MIKE	L.SALMELA	R.HEAD
HICKS CORP. 1671 HYDE PARK AVE. BOSTON 36, MASS. HY 3-2720	POLARIS	"		BOOSTER & JATO CASES			
	TALOS	"		BOOSTER METAL PARTS.			
	TERRIER III	"		SAME			
	BULL PUP	"		MOTOR CASES			
	HONEST JOHN	"		SAME			
HOFFMAN ELECTRONICS CORP. 3761 S. HILL ST. LOS ANGELES 7, CALIF. RI 7-4499	SIDEWINDER	"		GIMBAL ASSYS			
	TITAN	"		ELECTRONIC EQUIPMENT			
HEXCEL PRODUCTS, INC. 2332 FOURTH STREET BERKELEY 10, CALIF		EASTERN DIVISION OLD POST ROAD HAVRE DE GRACE, MD.	E				
C. G. HOKANSON COMPANY, INC. 3249 PONTIUS AVENUE LOS ANGELES 25, CALIF. GR 7-4231	THOR	"	E	GROUND AIR CONDITIONERS	R.HILMER		
	TITAN	"	C	GROUND AIR CONDITIONERS	R.HILMER		
	MINUTEMAN	"	B	PORTABLE AIR CONDITIONERS	L.SAMUELSON		
HOLIDAY TRANSFORMER CORP. 1910 KELSTON AVENUE CHICAGO 22, ILLINOIS AL 2-8500			B	TRANSFORMERS	C.DEHORN	J.HELLER	I.HIRSCH
HORKEY-MOORE ASSOCIATES TORRANCE, CALIFORNIA SP 5-1211	HOUND DOG	"		AMMONIA TRAILER	J.KERR	J.MOORE	P.C.CHILTON
	CORVUS	"		FORCE EJECTOR	SAME	SAME	SAME
	GENIE	"		FORCE EJECTOR	SAME	SAME	SAME
HOUDAILLE INDUSTRIES	SIDEWINDER	BUFFALO HYDR. DIV. 537 W. DELAVAN AVE. BUFFALO, N.Y. FI 8000		WARHEAD			
HUFFORD CORP. 1709 E. GRAND AVE. EL SEGUNDO, CALIF. OR 8-6221	POLARIS	"		LAUNCHING EQUIP.			
	TITAN	"		SAME			
HUGHES TOOL COMPANY CULVER CITY, CALIFORNIA UP 0-7111	ATLAS	AIRCRAFT DIV. FLORENCE AT TEALE CULVER CITY, CALIF JP 0-7111	D	LAUNCHER SECONDARY RELEASE	D.GRANT	G.YOUNG	M.TAYLOR
	ATLAS	SAME	E	PROPELLANT UTILIZATION SYSTEM	W.MELLOR	D.SCHNUEFLER	M.TAYLOR
	POLARIS	SAME	A	ROCKET ENGINES	H.SMITENE*		M.TAYLOR
	FALCON	SAME	E	CACHE ACTUATORS	R.BATZ		M.TAYLOR
	HONGOOSE	SAME	C	ARMAMENT FEED SYSTEM	R.COON		
	MINUTEMAN	SAME	D	PRESSURE VALVES	R.COON		
HUNTER-BRISTOL CORP. EMILIE ROAD BRISTOL, PA. WI 6-9150	ATLAS	"		SUPPORT EQUIP.			
	TITAN	"		SAME			
	SPARROW	"		SAME			
	THOR-ABLE	"		4TH STAGE ROCKET			
HUPP CORPORATION 6633 W. 65TH STREET CHICAGO 38, ILL. PO 7-2100		HUPP AVIATION DIV. 6633 W. 65TH ST. CHICAGO 38, ILL.	D	TURBO PUMP MACHINED PARTS	J. MORGAN	H. SAGE	J. DAVIS
HYAIR CORPORATION 1944 FLOWER STREET GLENDALE 1, CALIF. CH 5-5171	THOR	"	A	RELIEF VALVE	B.HELYMAN	B.ACKERHURST	D.BEARD
	FALCON	"	A	PRESSURE FUSE	SAME	SAME	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1—$10 million	G—$25—$50 million	I—$75—$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
HYDRODYNE CORPORATION 7343 COLDWATER CANYON AVENUE NO. HOLLYWOOD, CALIFORNIA PO 5-8001	POLARIS	"	A	NOZZLES	P.DURON	R.KERNAN	P.WURTZ
	MINUTEMAN	"	B	NOZZLES ACTUATORS	SAME	SAME	SAME
	VEGA	"	A	FILTERS	SAME	SAME	SAME
	ATLAS	"	A	FILTERS	SAME	SAME	SAME
HYDROMATICS, INC. 70 OKNER PARKWAY LIVINGSTON, N.J. BY 2-4900		"	D				
HYDRO-MILL COMPANY 1707 FLOWERFIELD BLVD. SANTA MONICA, CALIF. EX 4-0244		"	E				
			I				
INDIANA GEAR WORKS, INC. 1450 E. 19TH STREET INDIANAPOLIS 7, IND. ME 6-2591		"	E	TRANSMISSIONS GEARS & GEARBOXES	J. LEP	R. FELSE	P. DIRKS
INDUSTRO TRANSISTOR CORPORATION 35-10 36TH AVENUE LONG ISLAND CITY, N.Y. EX 2-6000	POLARIS	"	C	TRANSISTORS	A.MACDOUGALL	H.ISRAEL	V.ROSSANO
INERTIA SWITCH INC. 311 WEST 43RD ST. NEW YORK 36, N.Y. JU 6-5480	TITAN	"	B	ACCELERATION SWITCHES	J. GRILL	D. TUCKER	D. TUCKER
	SIDEWINDER	"	B	SAME	SAME	SAME	SAME
INTEGRAL CORP. 100 FRANK ROAD HICKSVILLE, N.Y. WE 1-4099	CORVUS	"		HYDRAULIC MICRO VALVES	F. LISSAU	S. WITTLESON	R. SHEA
		SAME		SAME	SAME	SAME	SAME
INTERNATIONAL RESISTANCE CO.	MINUTEMAN	"	B	ELECTRONIC COMPONENTS	J. INKEN		H. ZACCARIA
	POLARIS	PUERTO RICO		SAME		L. HAMBURG	W. HANSELM
	ATLAS	"	A	SAME	F. STERN	M. EIGELL	H. ZACCARIA
INTERNATIONAL TEL & TEL. CORP. 67 BROAD STREET NEW YORK 4, N.Y. BO 9-3600	NIKE	ITT FEDERAL DIV. 100 KINGSLAND RD. CLIFTON, N.J. *NO 7-3600	F	TRAINING	S. MOTTA	E. BERRY	H. WALLENBERG
	HOMARC	ITT FEDERAL DIV. 3301 WAYNE TRACE FT. WAYNE, IND. KE 5436	F	ELECTRONIC GROUND SUPPORT	A. RAABE R. BRIOUT R. DAVIS	J. MCGARRY E. MCGRATH R. HAMPSHIRE	J. KEENAN E. MORRINS F. MCKENNA
	SAGE	CLIFTON, N.J.	F	GROUND-TO-AIR CONTROL SYSTEM	A. ARNOLD	R. HAMPSHIRE	E. GRAY
	VORTAC	CLIFTON, N.J.	G	GROUND EQUIPMENT	T. ARMSTRONG	E. ENGELBERG	R. KEARNEY
	LACROSSE	CLIFTON, N.J.	F	GUIDANCE	W. FECKLER	A. RAABE	E. GRAY
INTERSTATE ENGINEERING CORP. 600 EAST VERMONT AVE. ANAHEIM, CALIF. PR 2-2472	ATLAS	"		COMPONENTS			
	NIKE	"	E		B.TAYLOR	H.SEITZER	G.MCMASTER
IRON FIREMAN MANUFACTURING COMPANY 2953 S.E. NINTH AVENUE PORTLAND 2, OREGON BE 4-6551	TERRIER	ELECTRONICS DIV. 2938 S.E. NINTH AVE PORTLAND 2, OREGON BE 4-6551	C	GYROSCOPE	R.HOCHSTETLER	H.THIEL	A.D.WOLFE
	TARTAR	SAME	C	SAME	SAME	SAME	SAME
	HP76	SAME	C	SAME	SAME	SAME	SAME
	30-19-8	SAME	C	SAME	SAME	SAME	SAME
	5074	SAME	C	SAME	SAME	SAME	SAME
	40-2-845	SAME	C	SAME	SAME	SAME	SAME
	40103-FD105	SAME	C	GYROSCOPES	R.HOCHSTETLER	H.THIEL	A.D.WOLFE
	CORVUS	SAME	A	SAME	SAME	SAME	SAME
	POLARIS	SAME	A	MICRO-MIN. RELAYS	SAME	SAME	SAME
	SATELLITE	SAME	A	SENSITIVE RELAY	SAME	SAME	SAME
	TACAN	SAME	C	SENSITIVE RELAY	SAME	SAME	SAME
	HOMARC A	AIRCRAFT DIV. 4784 S.E. 17TH AVE PORTLAND, OREGON BE 2-2121	C	STRUCTURAL MEMBERS	T.LUNDY	W.BUAO	R.BERTH
	HOMARC B	SAME	C	SAME	SAME	SAME	SAME
ITEMCO P.O. BOX 191 FORT WASHINGTON, N.Y.				ENVIRONMENTAL TEST FACILITIES	R.DEFLEARNS	E.MIGLIORE	J.ROSEN
			J				
JFD ELECTRONICS, INC. 6101 16TH AVE. BROOKLYN 4, N.Y. DE1-1000		JFD ELECTRONICS 1462 62ND ST. BROOKLYN, N.Y.	E	CAPACITORS TUNERS DELAY LINES	N. BERMAN	J. GOODMAN	R. KUTTNER

*Code for Approximate Contract Dollar Value

A — $10,000 — $ 50,000
B — $50,000 — $100,000
C — $100,000 — $500,000
D — $500,000 — $1 million
E — $1 — $10 million
F — $10 — $25 million
G — $25 — $50 million
H — $50 — $75 million
I — $75 — $100 million
J — $100 — $250 million
K — Over $250 million

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
JACK & HEINTZ, INC. P.O. BOX 6719 CLEVELAND 1, OHIO HO2-1000		4	D	ACTUATORS	H. MC CONNELL	C. HERBOLD	W. LLOYD
	LITTLE JOHN	4	A	LAUNCHER SPIN DRIVES	SAME	SAME	SAME
	BOMARC	4	D	GENERATORS AND REGULATORS	SAME	SAME	SAME
	POLARIS	4	C	MOTORS	SAME	SAME	SAME
	MARK	4	C	GUIDANCE COMPONENTS		SAME	SAME
	SPARROW III	4	C	SAME		SAME	SAME
JAMES POND & CLARK, INC. PASADENA, CALIF. MU1-4966	ATLAS	4		VALVES	D. VANDERLIN	W. SIMONS	W. OLSEN
	BOMARC			SAME	SAME	SAME	SAME
	TALOS	5		SAME	SAME	SAME	SAME
	MERCURY	4		SAME	SAME	SAME	SAME
JET PROPULSION LAB. DIV. C.I.T. PASADENA, CALIF.	SERGEANT	5		DESIGN & DEVELOPMENT			
	JUNO	4		SAME			
	CORPORAL	7		SAME			
	JUPITER	4		SAME			
	ECHO	4		SAME			
JET TOOL, INC. 7952 HORATH AVE. LEMON GROVE, CALIF. HO6-0471	POLARIS	3	A	GUIDANCE		C. HADLEY	
JONCO AIRCRAFT CORP. P.O. BOX 944 SHAWNEE, OKLAHOMA 6230		8	D	GROUND HANDLING AND SUPPORT	H. GRAY	G. KINARD	W. DRAKE

K

KAMAN & CO., INC. 541 WINDSOR ST. HARTFORD 2, CONN. CH 6-7431		4	D	GENERATORS, TEST EQUIPMENT	R. SHELDON	J. HOYT	F. JACOBS
KAISER ELECTRONICS, INC. 15 MONROE STREET UNION, N. J. MU 7-2525	POLARIS	3	A	POWER SUPPLIES	J. HU		F. KAISER
KAISER FLEETWINGS, INC. BRISTOL, PENNSYLVANIA ST 8-8431	POLARIS	4		MOTOR CASES	J. KARPAL	R. RICHARD	W. MEILBRUN
	ECHO	4		SATELLITE CONTAINER	H. FRICK	SAME	SAME
	JOMARC	4		PRESSURE VESSELS	H. FRICK	SAME	SAME
	MINUTEMAN	4		MOTOR CASES	E. BECKER	SAME	SAME
KAISER INDUSTRIES CORP.	POLARIS	AIRCRAFT & ELECTRONICS OAKLAND, CALIF. LO 2-2830		COMPONENTS & TEST CAPSULES			
	MATADOR	SAME		HANDLING & SERVICE EQUIPMENT			
	MINUTEMAN	SAME		SURVEY FOR TEST FACILITIES			
	TITAN	SAME		MACHINED PROPULSION COMPONENTS			
KAMAN AIRCRAFT CORPORATION OLD WINDSOR ROAD BLOOMFIELD, CONNECTICUT CH 2-4480	POLARIS	1 TEST LAS VEGAS 1 TEST LAS VEGAS COLORADO SPRINGS, COLO ME 4-2826	C	WARHEAD	A. BRIDGES		
	NIKE ZEUS	SAME		WARHEAD	D. STODDARD		
	NIKE ZEUS	SAME					
KAWARR CORPORATION 447 MARKET STREET KINGSTON, PENNSYLVANIA BU 7-2151		4	E	AIRFRAME PARTS	J. GEARHART	H. CALLETLY	C. SMITH
THE KAYDON ENGINEERING CORPORATION MUSKEGON, MICHIGAN MU 5-1691		4		ANTI-FRICTION BEARINGS	A. PENNA	D. HARTUNG	P. PIERRE
		PREVENTIVE DIV. MUSKEGON, MICH.		CONTOURING, GRINDING AND TURNING	H. CAMPBELL		W. PIERRE
KELSEY HAYES CO. 3600 W. MILITARY DETROIT 3, MICH. TA 5-5000		4	C	MISSILE INERT COMPONENTS	E. HAYES	S. WATANABE	A. NORTON
KEMP AERO PRODUCTS MARSHALL HILL ROAD WEST MILFORD, NEW JERSEY	TALOS	4		DAMPERS VALVES			
	NIKE	4		VALVES			
KENTUCKY METAL PROD. CO. 3104 S. PRESTON ST. LOUISVILLE 13, KY. ME 4-9421		4	A	WELDED HONEYCOMB CORE	S. EMISON	J. COVERT	C. BLACKSHEAR
KIM HOTSTART MFG. CO. 917 E. BROADWAY SPOKANE, WASH. FA 8-4020		4	A	ENGINE PRE-HEATERS	H. RANDALL	H. RANDALL	H. RANDALL
KINGS ELECTRONICS CO., INC. 40 MARBLEDALE ROAD TUCKAHOE 7, NEW YORK SW 3-5000		4	E	RF CONNECTORS ANTENNAS ATTENUATORS			
KITTELL-LACY, INC. 10815 EAST FAIRCETT EL MONTE, CALIF. GI 4-9561	REGULUS II	4	C	TEST FACILITIES	R. GAINER		K. CLOE
KLINCHER LOCKNUT CORPORATION INDIANAPOLIS 18, INDIANA WA 5-9284		4	D	FASTENERS	E. PUMMILL	H. HENLEY	I. STEINHART
KUTHE LABORATORIES, INC. 730 SO. 13TH STREET NEWARK 3, NEW JERSEY BI 2-6000		4	E	TUBES, ELECTRON THYRATRON	Z. GORDON	J. HYERS	

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1—$10 million	G—$25—$50 million	I—$75—$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
			L				
LAMINATED SHIM COMPANY, INC. UNION STREET GLENBROOK, CONN.			E	SHIMS-STAMPINGS	O. HECHT	O. HECHT	F. THOMAS
LANG-AIR, INC. 7444 WEST WILSON AVENUE CHICAGO 31, ILL. UN 7-7550		PATTERN X-RAY DIV. 7444 WILSON AVE. CHICAGO, ILL.	E	X-RAY EQUIPMENT	A. BROWN	E. MORITZ	C. MITCHELL
		FIELD OPERA. DIV.	E	MAINTENANCE ELECTRONIC EQUIP	D. BANNISTER	W. OLD	C. MITCHELL
		SPECIAL PROJECTS DIV.	C	TECHNICAL SERVICES	R. NELSON	G. YOUNG	D.C. MITCHELL
		CHEYENNE DIVISION MUNICIPAL AIRPORT CHEYENNE, WYO. CH 2-6481	E	ENGINEERING OF ELECTRONIC EQUIP	R. WARNIMER	J. SHELTON	O. SEELY
		STEPPER MOTORS CORP. 1732 W. SLAUSON LOS ANGELES 47, CAL. AX 5-5821	C	PRECISION INCREMENTAL MOTORS	C. ADAMS	M. HAGER	J. SCALES
		INSTRUMENT & ELEC. DIV. 2133 ADAMS AVE. SAN LEANDRO, CAL. LO 9-5881	C	SUBMINIATURE RADIO RECEIVERS	G. BERK	K. CUNNINGHAM	L. ANDERSON
		WHITE SANDS-HOLLOMAN P.O. BOX 594 HOLLOMAN AFB, N.M. GR-36511	F	GROUND SUPPORT EQUIPMENT			
		POINT MUGU DIV. PACIFIC MISSILE RANGE PT. MUGU, CALIF. HL 6-1681	E	ELECTRONIC DATA REC			
		CHICAGO ELECTRONICS 4751 N. OLCOTT AVE. CHICAGO, ILL. UN 7-7550	E	ELECTRONIC MECHANISMS			
THE LANGSVERK ELECTACHEIER COMPANY 641 SONORA AVENUE GLENDALE 1, CALIFORNIA CH-56647		"	D	RADIATION MEASURING INSTRUMENTS			
LANSLEY CORPORATION 3145 DALIO AVENUE SAN DIEGO 12, CALIF. CO 4-3181		"	D	FUEL LINE SYSTEM	S. SANDELMAN	C. SNYDER	P. KEEVES
LASKO METAL PRODUCTS INC. 438 W. JAY STREET WEST CHESTER, PA. OR 6-0700	SIDEWINDER	"	D	CONTAINERS	L. LASKO	F. GOTTIER	C. GRUBER
LAVEZZI MACHINE WORKS 6633 WEST LAKE STREET CHICAGO 48, ILL. ES 8-1636		"		PRECISION MACHINE PARTS	LA VEZZI	F. SPEH	J. KREMER
LEACH CORP. 18435 SUSANA ROAD COMPTON, CALIF. NE 6-1071	JUPITER	"		MOTOR GENERATORS			
	POLARIS	RELAY DIV. 5915 AVALON BLVD. LOS ANGELES, CALIF. AD 2-6221		LAUNCHERS, ELECTRICAL RELAYS			
	ATLAS	SAME		RADAR & GROUND CONTROL	SAME		
	THOR	SAME		HANDLING & SERVICE EQUIPMENT			
	TITAN	SAME		INSTRUMENTATION			
	JUNO	SAME					
LEAR INC. 3171 S. BUNDY DRIVE SANTA MONICA, CALIF. EX 8-6211	HOMARC	"		CONVERTER SYSTEM			
	NIKE-ZEUS	GRAND RAPIDS DIV. GRAND RAPIDS, MICH. 110 INDIA AVE. GL 1-1555					
THE LEE COMPANY 523 BOSTON POST ROAD OLD SAYBROOK, CONN. EV 8-3564		"	C	DIPOLE FUEL NOZZELS	T. FLANAGAN	R. DOOLITTLE	F. SHIELDS
LEEMATH INCORPORATED OAK DRIVE SYOSSET, L. I., NEW YK. WA 1-3080	POLARIS	"		GUIDANCE COMPONENTS	D. SHAW	W. RAUSCH	J. LESKJECHER
	TITAN	"		SAME	SAME	SAME	SAME
	ATLAS	"	E	SAME	SAME	SAME	SAME
LEEMATH INCORPORATED OAK DRIVE SYOSSET, L. I., NEW YK. WA 1-3080	POLARIS	"		GUIDANCE COMPONENTS	D. SHAW	W. RAUSCH	J. LESKJECHER
	TITAN	"		SAME	SAME	SAME	SAME
	ATLAS	"	E	SAME	SAME	SAME	SAME
LEHIGH VALLEY ELECTRONICS ENG. ALLENTOWN, PENNSYLVANIA HE 5-3661		"	A	RESEARCH APPARATUS, TS-603 UNITS AND OSCILLATORS	A. SIMPSON SAME	W. GRUVER SAME	R. SHIMER SAME
LEL INC. 380 OAK STREET COPIAGUE, NEW YORK. AM 4-2200	ATLAS			AMPLIFIERS	R. MURPHY		C. LUPO
	NIKE HERCULES			SAME	C. BAKER		C. LUPO
	NIKE ZEUS			SAME	D. MCEACHRON		C. LUPO

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000 C—$100,000—$500,000 E—$1—$10 million G—$25—$50 million I—$75—$100 million K—Over $250 million
B—$50,000—$100,000 D—$500,000—$1 million F—$10—$25 million H—$50—$75 million J—$100—$250 million

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
LINDBERG ENGINEERING CO. CHICAGO 12, ILL.	MINUTEMAN	#		FURNACES & INDUCTION HEATING			
	HONEST JOHN	#		SAME			
	NIKE HERCULES	#		SAME			
	SERGEANT	#		SAME			
	HARK	#		SAME			
	SPARROW	#		SAME			
	RECRUIT	#		SAME			
LOCKHEED AIRCRAFT CORP., BURBANK, CALIF. TR 7-2711	POLARIS	LOCKHEED M&S DIV., SUNNYVALE, CAL. RE 9-4321		MISSILE SYSTEM	S. BURRISS	R. GIBSON	P. GODWIN
	DISCOVERER	SAME		SATELLITE SYSTEM	J. PLUMMER	N. MILAKOVICH	M. MC GILVRAY
	MIDAS	SAME		SAME	J. KNOPOW	SAME	SAME
	SAMOS	SAME		SAME	W. TYMINSKI	SAME	SAME
	KINGFISHER	SAME		TARGET MISSILE	L. STAEHLE	R. ROBINSON	G. JOHNSON
	X-7	SAME		RAMJET TEST VECHILE	SAME	SAME	SAME
	Q-5	SAME					
	JUPITER	SAME		IV SYSTEMS			
	X-7	SAME					
	SENTRY	SAME		COMPLETE SPACE SYSTEM			
	PIED PIPER	MISSILE SYSTEMS DIV., 7701 WOODLAY AVE., VAN NUYS, CALIF. ST 6-4210					
	X-17	SAME					
	DISCOVERER	SAME		DESIGN			
	KINGFISHER	SAME		TARGET SYSTEM DEVELOPMENT			
	X-17	GEORGIA DIV., MARIETTA, GA. 9-9411					
	BOMARC	MISSILE SYSTEMS DIV.		TESTING			
	MIDAS	SAME		PRIME CONTRACT			
LOOSE AND SHIPLEY CO., 3055 COLERAIN AVE., CINCINNATI 25, OHIO. KI 1-4774	CORVUS	FLOTURN DIV.	A-	METAL PARTS	WAMKEN	SCHNIEDERS	WAMKEN
	SIDEWINDER	SAME	A	SAME.	SAME	SAME	SAME
LONE STAR PLASTICS CO., INC., 124 ROBERTS CUTOFF, FORT WORTH, TEXAS. PE 2-1437	TERRIER	#	C-	HIGH TEMPERATURE PLASTICS	E.H. SHAFEY	C.F. PERRIN	T.C. HALE
LUMINATOR, INC., 120 N. PEORIA, CHICAGO 80, ILL. DE 7-0737	ATLAS	#	B	ELECTRICAL COMPONTS	O. RAHN	R. LEMEN	C. HUREK
	THOR	#		SAME	SAME	SAME	SAME
	NIKE	#		SAME	SAME	SAME	SAME
	SERGEANT	#		SAME	SAME	SAME	SAME
LYNCOACH AND TRUCK CO., INC., 441 CHESTNUT STREET, ONEONTA, NEW YORK. GE 2-2900	JUPITER	#	E	TRAILERS	F. HUMPHREYS	W. BICKENHOFER	R. STRAIT
	REDSTONE	#		SAME	SAME	SAME	SAME
			M				
MPM, INCORPORATED, 9110 GEORGE AVENUE, CLEVELAND 5, OHIO. BR 1-4456	POLARIS	#		JETEVATORS, NOZZLES, INSERTS, CLAMPS	T. LEE	F. HARINKO	A. COOK
	MINUTEMAN	#	C	SAME	SAME	SAME	SAME
MCCULLOCH CORPORATION, 6101 WEST CENTURY BLVD., LOS ANGELES 45, CALIF. OR 0-2320		#	P	RECIPROCATING ENGINES/DRIVES	J. DILWORTH	E. DISCOE	C. HAMMOND
MCDONNELL AIRCRAFT CORPORATION, P. O. BOX 516, ST. LOUIS 66, MISSOURI.	MERCURY	#	G	SPACE CAPSULE, MISSILE ADAPTERS	E. FLESH	W. DUBUSKER	K. HAGENKNECHT
	QUAIL	#	J	GROUND SUPPORT & CHECKOUT EQUIP	SAME	SAME	SAME
MCCORMICK SELPH ASSOCIATES, HOLLISTER AIRPORT, HOLLISTER, CALIF. HE 7-3731	MERCURY	#		GAS GENERATOR SYSTEM	F. LAHAYE	L. WILSON	A. SCHNIEDER
	TITAN	#		EXPLOSIVE DEVICES	SAME	SAME	SAME
	DISCOVERER	#		STAGE SEPARATION VALVES	SAME	SAME	SAME
	POLARIS	#		STAGE SEPARATION, IGNITION	SAME	SAME	SAME
	SPARROW III	#		EXPLOSIVE COMPONENTS	SAME	SAME	SAME
	SIDEWINDER	#		GAS GENERATORS	SAME	SAME	SAME
	NIKE-HERCULES	#		EXPLOSIVE DEVICES	SAME	SAME	SAME
	ATLAS	#		PRESSURE CARTRIDGES	SAME	SAME	SAME
	JUNO	#		IGNITER & STAGE SEPARATION	SAME	SAME	SAME
	BOMARC	#		EXPLOSIVE DEVICES	SAME	SAME	SAME
	HARK	#		SAME	SAME	SAME	SAME
	MINUTEMAN	#		SAME	SAME	SAME	SAME
	EXPLORER	#		IGNITER & STAGE SEPARATION	SAME	SAME	SAME
MAGNETICS, INC., 6 AICHTER COURT, EAST NORTHPORT, L.I., N.Y. AN 1-4502		#	D	COILS & AMPLIFIERS	H. EICHER	E. SHYNE	N. O'BRIEN
MARQUARDT CORP., 16555 SATIEOY ST., VAN NUYS, CALIF. ST 5-8361	KINGFISHER	#		RAMJET BOOSTER			
	BOMARC	#		RAMJET ENGINES			
	HOUND DOG	#		VARIABLE INLET CONTROL SYS.			
	X-7	#		RAMJET BOOSTER			
	MILO	#		RAMJET ENGINES			
	PLUTO	#		PRIME CONTRACT			

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1—$10 million	G—$25—$50 million	I—$75—$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)		$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
THE MARTIN COMPANY BALTIMORE 3, MARYLAND MU 7-3600	TITAN	DENVER DIV., P.O. BOX 179 DENVER 1,COLO.	PY 4-5211	K	AIRFRAME	A. HALL	R. BLAKEY	C. BLOOMER
	MACE	BALTIMORE DIV., BALTIMORE, MD.		K	SYSTEM	D. GAGE	J. TOY	A. ROSE
MAST DEVELOPMENT COMPANY, INC. DAVENPORT, IOWA. 3-9729					TEST EQUIP., PLOTTERS	GANNETT	NIEMEYER	FIEN
G. E. MATHIS COMPANY, 6103 SOUTH OAK PARK AVENUE CHICAGO 38, ILL. LU 6-3600	"	"		A	MICROWAVE TOWERS	A. GRASIS	S. STANCIK	R. LEHNERT
	"	"		A	MICROWAVE TOWERS & REFLECTORS	SAME	SAME	SAME
	"	"		B	MICROWAVE TOWERS & REFLECTORS	SAME	SAME	SAME
THE W. L. MAXSON CORPORATION 475 TENTH AVENUE, NEW YORK 18, N. Y. LO 5-1900	CORVUS	460 W. 34TH ST., NEW YORK, N.Y.		E	MISSILE GUIDANCE	E. UTTENDORFER		
	TERRIER	SAME		F	LAUNCHER CONTROL CONSOLE	M. SACKSON		
	THOR	SAME		C	SAFETY & ARMING DEVICE	SAME		
	HARK	SAME		D	COMPONENT DEVELOPMENT	M. KAHN		
	FALCON	MFG. DIV., 5 MAXSON DRIVE OLD FORGE, PA.	GL 7-5406	E	FUZE		J. MOINOWSKI	
	SPARROW III	SAME		D			SAME	
	HIKE	SAME		E	COMPONENTS		SAME	
	TITAN	RES. & DEV. DIV., 460 W. 34TH ST., NEW YORK 1, NY	LO 5-1900	P	FREQUENCY CONTROL UNITS		SAME	
	GAR-9	SAME		C	SAFETY AND ARMING MECHANISMS	G. KAHN		
NELPAR INC., P.O. BOX 126 3003 ARLINGTON BLVD., LAKE ORION, MICH. MY 2-2711 FALLS CHURCH, VA. JE 4-6000	JUPITER	"			ORDNANCE DEVICES			
	TALOS	"			FUSE			
	ATLAS	"			RADAR BEACONS, TEST EQUIPMENT			
	THOR	"			(RADAR BEACONS)			
	TITAN	"			SAME			
	MERCURY	"			MICRO-WAVE TRACKING			
MENASCO MFG. CO. 805 SAN FERNANDO BLVD. BURBANK, CALIF. VI 9-3261	ATLAS	"			TITANIUM PRESSURE VESSELS			
	CORVUS	"			SAME			
MENLO RESEARCH LABORATORY 595 NORTH MATHILDA AVENUE, SUNNYVALE, CALIF. RE 9-6700	MIDAS	"		C	MISSILES	R. KAVINOKY		
*METAL BELLOWS CORP., P.O. BOX 92 MEATON 49, FALLS, MASS. CE 5-1940	POLARIS	"			COMPENSATOR BELLOWS			
	HIKE	"			SAME			
	HOUNDOG	"			SAME			
	ATLAS	"			SAME			
	MINUTEMAN	"			SAME			
	HOMARC	"			SAME			
METALECTRO LABORATORY 11429 VANOWEN STREET, NO. HOLLYWOOD, CALIF. DO 5-2430		"		C	GROUND HANDLING & MEMORY SYS.	PEACH	J. SCHIELD	M. PIPES
METALLIZING COMPANY OF LOS ANGELES 1253 SO. BOYLE AVE., LOS ANGELES 23, CAL. AN 8-7108		"		C	ROKIDE & CERAMIC COATINGS	L. HEMMER	S. BROWN	M. WHITE
METCOM CORPORATION		"		A	SERVO ANALYZERS	A. DEL GUCCA	G. ARMSTRONG	R. GARDNER
					AC ELECTRONIC POWER SUPPLIES	SAME	SAME	SAME
					GYRO DRIFT RECORDERS	SAME	SAME	SAME
					TRANSISTORIZED DC POWER SUP	SAME	SAME	SAME
					ALTITUDE CONTROLLERS	SAME	SAME	SAME
					ANGULAR ACCELEROMETERS	SAME	SAME	SAME
*MERCURY AIR PARTS CO. INC. 9711 WEST JEFFERSON BLVD., CULVER CITY, CALIF. UP 05923	ATLAS	"			HIGH TEMPERATURE FASTENERS	J. GLOVER	I. BIRKEN	I. STEINMAN
	TITAN	"			*HI-TEMP. PARTS	J. GLOVER	I. BIRKEN	I. STEINMAN
	JUPITER	"			SAME	SAME	SAME	SAME
	POLARIS	"			SAME	SAME	SAME	SAME
	HOMARC	"			SAME			
MICRO GEE PRODUCTS, INC. 6916 WEST SLAUSON AVE., CULVER CITY, CALIF. EX 1-6719		"		C	PRECISION TEST EQUIPMENT	B. MEFADDEN	D. YORK	B. LOSHANDY
MICROTRAN CO. INC. 185 SO. MINEOLA AVE., VALLEY STREAM, N.Y. LO 1-8050	POLARIS	"		C	TRANSFORMERS	R. CHABER	H. EDELSTEIN	B. BELL
MIDLAND-ROSS CORP., 6665 MT. ELLIOTT DETROIT, MICH.		JANITROL DIV., 4200 SURFACE RD., COLUMBUS 4, OHIO	BR 4-3561	D	PNEUMATIC CONTROLS	H. DECKER	E. AUPPERT	R. RUPP
				C	COUPLINGS	SAME	H. OSBORN	J. HUNTLEY
				D	HEAT EXCHANGERS	C. ALDRICH	R. FIELDING	R. RUPP
				C	LIQUID HEATERS	D. CLARK	C. MARTIN	R. RUPP
				D	COMBUSTION EQUIP.	SAME	SAME	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
MIDWESTERN INSTRUMENTS P. O. BOX 7186, TULSA 16, OKLA. RI 7-1331	"	"	E	ELECTRONIC DATA RECORDING INSTR	E. SEAMAN	E. SCHUCTHEIS	R. KENNEDY
MILL POLISHING CORPORATION HUNTINGTON PARK, CAL. LU 7-2171	"	"	C	PRECISION METAL PARTS	J. PAYNE		P. OVEYAEL
MILRO CONTROLS, CO., *SADDLE BROOK, N. J. SU 1-1850	POLARIS	"	C	REACTOR CONTROL D-C POWER SUP	H. ROSEN	W. EMMERSON	H. V. CORONATO
	"	"		FLASHING BUS POWER SUPPLY	SAME	SAME	SAME
	POLARIS	"	A	POWER SUPPLY	SAME	SAME	SAME
MINNEAPOLIS-HONEYWELL REGULATOR CO 2753 4TH AVE., S MINNEAPOLIS 8, MINN. FE 2-5225	MERCURY	AERONAUTICAL DIV. 2600 RIDGWAY RD. MINNEAPOLIS 13, MINN ST 1-6011	E	CONTROL SYS. GROUND SUPPORT	R. CRASK	E. LUND	R. FOSTER
	TITAN	SAME	E	GUIDANCE	H. HENDERSON	SAME	SAME
	CENTAUR	SAME		COMPONENTS	P. ANDREWS	SAME	SAME
	M-252	SAME		AIR DATA COMPUTER	R. MEYERS	SAME	SAME
	SERGEANT	SAME		GYROS & ACCELEROMETERS	J. LOWER	SAME	SAME
	AAG TAIL	MISSILE DEV. LAB. 1919 ARMACOST AVE. LOS ANGELES, CAL. GR 8-1281	C	SYSTEM	W. WRIGHT		W. MARCY
	SCOUT	SAME	C	GUIDANCE	SAME		SAME
	#511TL	SAME	D	SAME	SAME		SAME
	THOR-DELTA	SAME	E	SAME	SAME		SAME
	2094	SAME	E	SAME	SAME		SAME
	MERCURY	BOSTON DIV. BOSTON, MASS. AL 4-5200	A	GYROS	T. MAPLES	J. LILLIS	E. HANSCOM
	HOUNDOG	SAME	C	GYROS & ACCELEROMETERS	SAME	SAME	SAME
	ATLAS	SAME	D	GYROS	SAME	SAME	SAME
	THOR	SAME	C	SAME	SAME	SAME	SAME
	TITAN	SAME		ACCELEROMETERS	SAME	SAME	SAME
	MINUTEMAN	SAME	C	SAME	SAME	SAME	SAME
	LITTLE JOHN	ORDNANCE DIV. 600 SECOND ST. HOPKINS, MINN. WE 8-3571		ARMHEADS	J. ENGDAHL	G. LILLICROP	J. BARRETT
	HONEST JOHN	SAME		SAME	SAME	SAME	SAME
	SERGEANT	SAME		SAME	SAME	SAME	SAME
	MINUTEMAN	SAME		ARMING & GROUND SUPPORT	SAME	SAME	SAME
	TALOS	SAME		ARMING	SAME	SAME	SAME
	SIDEWINDER	SAME		ORDNANCE	SAME	SAME	SAME
	TERRIER	SAME		SAME	SAME	SAME	SAME
	ASROC	SAME		SYSTEM & TRAINERS	SAME	SAME	SAME
	MERCURY	SAME		COMPONENTS	SAME	SAME	SAME
	ATLAS	MISSILE EQUIP DIV. QUEENS S. BAILEY POTTSTOWN, PA. FA 3-4000	E	GROUND SUPPORT	F. DAVIS	H. MOVING	M. JONES
	SCMARC	SAME	E	SAME	SAME	SAME	SAME
	TITAN	SAME	D	SAME	SAME	SAME	SAME
	CENTAUR	INERTIAL GUIDANCE DIV. ROUTE 19 ST. PETERSBURG, FLA. HE 5-1151		GUIDANCE	W. ERFLINOFF		
	POLARIS	SAME		SAME	J. ANDERSON	L. SWIFT	B. PUFFER
	SCMARC	SAME		SAME	SAME	SAME	SAME
MINNESOTA MINING & MANUFACTURING 900 BUSH AVENUE, ST. PAUL 6, MINN. PR 6-8511		3M COMPANY, CENTRAL RES., 2301 HUDSON RD., ST. PAUL 6, MINN.	E	SOLID PROPELLANTS	G. HATHMANN		
	POLARIS	ZENITH PLASTICS CO., SUBS., 1600 W. 135TH ST., GARDENA, CAL.	C	MISSILE CONTAINERS LINERS		D. SCHICK	
	NIKE-HERCULES	SAME	C	RADAR REFLECTOR ASSEMBLIES		A. KOVALCHUK	
MITCHELL CAMERA CORPORATION 666 WEST HARVARD ST., GLENDALE 4, CAL. CH 5-1085	"	"	E	16 35 70MM CAMERAS	E. MANDERFELD	J. LOCALL	M. KREUSCHER
MOLDED INSULATION CO. 339 E. PRICE ST., PHILADELPHIA 44, PA. VI 4-2626	NIKE-ZEUS	"	A	CONNECTORS	J. AICHINGER	M. GARRITY	W. MALOMAR
	POLARIS	"	B	PRINTED CIRCUIT ASSEMBLY	F. MITCHELL	J. FINLET	M. MALAMAR
MOTOROLA INC. 4545 W. AUGUSTA BLVD. CHICAGO 51, ILL. SP2-6500	SCMARC	WESTERN MILT. EL. CTR. 8201 E. MCDOWELL RD. SCOTTSDALE, ARIZ. WH5-4311	E	BEACON DEVELOPMENT	L. DIVEN	J. THOMPSON	P. HUGHES
	SCMARC	SAME	E	DATA LINK	B. BLACKART	SAME	SAME
	SCMARC	SAME	E	GUIDANCE TRANSPONDER	L. DIVEN	SAME	SAME
	MOHAWK	SAME	E	SLAR DEVELOPMENT	J. EDSON	SAME	D. BENSON
	SIDEWINDER	SAME	E	GUIDANCE	A. LAHTI	J. THOMPSON	O. BUSKIRK
	SD-2	SAME	E	DRONE NAVIGATION AND CONTROL	W. F. PETERSON	SAME	D. BENSEN
	SAGE	CHIC. MILT. EL. CTR. 1450 N. CICERO CHICAGO 14, ILL.	E	COMMUNICATION SYSTEM	B. GRIFFITH	J. SCHULTZ	J. O'DONNELL
	DRONE TARGET	MOTOROLA SYS. RES. LAB 8330 INDIANA AVE. RIVERSIDE, CALIF.	D	DRONE TARGET SEEKER	B. FLETCHER		E. HUTT
MYCALEX CORPORATION OF AMERICA 125 CLIFTON BLVD. CLIFTON, N.J. PR9-8864	"	"		ELECTRONIC COMPONENTS	H. RICHARDSON	A. BACKUS	H. WESTERVELT
		SYNTHETIC MICA CO. DIV. CALUMET TOWNSHIP, N.J. CA6-4020		SAME	H. RICHARDSON	H. RICHARDSON	H. WESTERVELT
		MYCALEX ELECT. CORP. 125 CLIFTON BLVD. CLIFTON, N.J.		SAME SAME	A. BACKUS A. BACKUS	E. DEVICEROY G. LYNCH	H. WESTERVELT H. WESTERVELT
MUTRON CORPORATION 125 PERKINS AVE. BROCKTON, MASS. JU 3-0033	HARK	"	A	CABLE ASSYS.	H. FORSBERG	E. OZELIUS	R. ANDERSON

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

N

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
N.J.E. CORPORATION 345 CARNEGIE AVENUE KENILWORTH, NEW JERSEY CH 1-1500		#		ELEC. POWER UNITS FOR ATLAS, POLARIS, TALOS, TITAN, NIKE	S. GLASSMAN	R. SCHLENKER	R. SCHRAGE
NAVAL GUN FACTORY WASHINGTON, D.C.	SIDEWINDER TALOS TARTAR	# # #		WARHEAD METAL PARTS LAUNCHERS PROPULSION METAL PARTS			
NAVIGATION COMPUTER CORP. 1621 SNYDER AVENUE PHILADELPHIA 45, PENNA. HO 5-7700	POLARIS	#	C	DIGITAL FUNCTION GENERATOR	J. JONES	A. ROSSI	J. NEWELL
	MINUTEMAN	#	B	TIME BASE GENERATOR	J. JONES	A. ROSSI	J. NEWELL
NEW DEPARTURE DIV., GENERAL MOTORS 269 NORTH MAIN STREET BRISTOL, CONNECTICUT LU 2-6371		NEW DEPARTURE HAYES AVENUE SANDUSKY, OHIO MA 6-2120		INSTRUMENT BEARINGS FOR GUIDED MISSILES, SIDEWINDER, THOR, MACE, FALCON, REGULUS, MERCURY, NIKE, REDSTONE, JUPITER, PERSHING, POLARIS, TITAN	P. BALLACK	F. HIMMELEIN	W. RYAN
NEW ENGLAND LAMINATES CO., INC. 481 CANAL STREET STAMFORD, CONNECTICUT DA 4-4191	HAAK	#	A	MOLDED LAMINATES	D. EVDAS	J. BAKER	C. LOCKTON
NEW LONDON INSTRUMENT CO., INC. 62 UNION STREET NEW LONDON, CONNECTICUT GI 3 8491		#	B	TELEMETRY TEST EQUIPMENT	D. PALLACK	I. KADESH	A. FRANCO
NEWARK CONTROLS COMPANY 15 WARD ATHLET BLOOMFIELD, NEW JERSEY PI 8-2471		#	A	INSTRUMENTATION, FIRE EXTING	B. HICKS	G. WALKER	D. HESS
NIKON, INC. 111 FIFTH AVENUE NEW YORK 3, NEW YORK OR 4-7470		#	B	OPTICAL COMPARATORS	NAGAYA	THOKE	YAMANAKA
NORRIS-THERMADOR CORPORATION 5215 SOUTH BOYLE AVENUE LOS ANGELES 58, CALIF. LU 8-7111	POLARIS	#	E	MOTOR CASES	C. HAWORTH	D. HAAG	R. STODDARD
	SIDEWINDER		B	MOTOR ASSY'S	R. GROOT	E. CHAMBERLAIN	SAME
	T-23A ROCKET	#	C	METAL PARTS	R. THOMAS	J. DEIRO	SAME
	T-27J ROCKET	#	M	SAME	R. CARRIO	J. DEIRO	SAME
	SUPER TALOS	#	C	SAME	F. KUHLMAN	E. CHAMBERLAIN	SAME
	TERRIER	#	A	SAME	D. HAMILTON	J. DEIRO	SAME
	ARCAS	#	A	MOTOR CASE	F. KUHLMAN	J. DEIRO	R. STODDARD
	FALCON	#	C	SAME	C. GROOF	E. CHAMBERLAIN	SAME
NORTH AMERICAN AVIATION, INC. 1700 E. IMPERIAL HIGHWAY EL SEGUNDO, CALIF OR 8-3011	MOUNDOG	MISSILE DIV. 12214 LAKEWOOD BLVD. DOWNEY, CALIF. SP 3-0610		SYSTEM	M. DOF	J. CUNNINGHAM	M. STARR
	LITTLE JOE	SAME		BOOSTER LAUNCHER	SAME	SAME	SAME
	ATLAS	ROCKETDYNE DIV. 6633 CANOGA PARK, CAL. DI 7-5581		ROCKET ENGINES	E. NOWLRATH		
	THOR	SAME		SAME	D. THORSEN		
	F-1 ENGINE	SAME		SAME	D. ALDRICH		
	H-1 ENGINE	SAME		SAME	R. HEALY		
	JUPITER	SAME		SAME	SAME		
	REDSTONE	SAME		SAME	B. WILLIAMS		
	A5-2 SLED ENG.	SAME		SAME	W. BAYNE		
	E-1 ENGINE	SAME		SAME	D. ALDRICH		
	DYNA-SOAR	AUTONETICS DIV. 9150 E. IMPERIAL DOWNEY, CALIF. SP 3-2233		GUIDANCE & CONTROL STUDY	R. ASHBY	J. EMMI	C. RAFTERY
	SNAP	ATOMICS INTERNATL CANOGA PARK, CALIF. DI 7-7200		NUCLEAR POWER SYS.	J. ARTCH		
	PLUTO	SAME		NUCLEAR RAMJET	J. HOKE		
NORTH AMERICAN ELECTRONICS, INC. 71 LINDEN STREET WEST LYNN, MASSACHUSETTS LY 8-4400		#	C	SEMICONDUCTORS	A. BAUM	H. WAELTER	M. WUNO
NORTHERN ORDNANCE, INC. 48TH & N.E. MARSHALL MINNEAPOLIS, MINN. SU 8-8601	TALOS	#		LAUNCHERS, MISSILE LOADER COMP			
	TARTAR TERRIER II	# #		LAUNCH SYSTEM POWER DRIVES, LAUNCHERS			
NORTHROP CORPORATION BEVERLY HILLS, CALIFORNIA CR 4-8061	SNARK	NORAIR DIV. 1001 E. BROADWAY HAWTHORNE, CALIF. OR 8-9111		WEAPON SYSTEM	J. MATTHEWS	H. FAYRWEATHER	C. HOOD
NORTHWESTERN ELECTRIC COMPANY 1710 N. SPRINGFIELD AVENUE CHICAGO 47, ILLINOIS		#	A	MOTORS-GENERATORS	W. ABBOTT	W. SMITH	P. CHRISTIANSEN
NUCLEAR CORPORATION OF AMERICA 2 RICHWOOD PLACE DENVILLE, NEW JERSEY OA 7-4200	TALOS	CENTRAL ELECTRON. DIV.	D	COMPONENTS	K. RUSINOW	H. HOLDEN	M. BUFF
	NIKE	SAME	C	SAME	P. GREENBERG	SAME	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1—$10 million	G—$25—$50 million	I—$75—$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
O							
THE OHIO CARBON COMPANY 12508 BEREA ROAD CLEVELAND 11, OHIO CL 2-6100			B	COMPONENTS	C. ADAMS	R. GRAF	F. AURAND
OPTIMIZED DEVICES, INC. 864 FRANKLIN AVENUE THORNWOOD, NEW YORK RO 9-6110			B	AUTOMATIC TEST EQUIPMENT	S. BERNSTEIN	J. MURTHA	A. ZUCH
OREGON METALLURGICAL CORPORATION P.O. BOX 484 ALBANY, OREGON WA 6-4281	POLARIS	#	C	REFRACTORY NOZZLE THROAT INSERT		F. CAPUTO	N. SAMS
	MINUTEMAN	#	C	SAME		SAME	SAME
JOHN OSTER MFG. CO. 1 MAIN STREET RACINE, WISCONSIN ME 7-4445		#	F	ROTATING COMPONENTS SERVO-MECH	W. JEFFERSON	S. MURRAY	P. SMITH
OTIS ELEVATOR COMPANY 35 MYERSON STREET BROOKLYN 5, NEW YORK UL 5-6600	POLARIS	DEFENSE & INDUST. DIV.	E	OPTICAL CART CONTROL SYSTEM	P. FINN		
	DISCOVERER	SAME	E	GROUND SUPPORT EQUIPMENT	J. KENT	H. BOHNING	J. VARDEN
	ATLAS	SAME	E	TEST EQUIPMENT	J. MCKINLEY	L. VANDER-BOKKE	A. VELTO
	JUPITER	SAME	E	GATES & CONTROLS GROUND SUP	N. GERIL		
P							
P.B.R. MANUFACTURING COMPANY H AND LUZERNE STREETS PHILADELPHIA 24, PENNA. GA 6-0932		#	C	DOLLIES AND INSTRUMENT CARTS	Z. RACHMAN	A. SCHMITT	J. MANFREDONIA
PACE ENGINEERING COMPANY 13035 SATICOY STREET NORTH HOLLYWOOD, CALIF. PO 5-0453		#	D	TRANSDUCERS, ACCELEROMETERS, THERMOCOUPLE JCTS.	S. EPSTEIN	J. FRIEL	W. JOHNSTON
PACIFIC COAST ENGINEERING CO. OAK AND CLEMENT ALAMEDA, CALIF. LA 2-6100	SATURN	#	C	TOWER TRUCKS, CARNES, HOISTS	C. ZREIFFL	N. ROBERSON	L. COMPIANO
PACIFIC MAGNETIC CORP. POMOLAND, CALIFORNIA OL 7-2637	MERCURY	#	C	MAG, AMPS, & SWITCHING SYS.	G. JOHNSON	H. MILLS	E. ECKSTEIN
PALOMAR EQUIPMENT COMPANY 4254 NIAGARA AVENUE SAN DIEGO 7, CALIFORNIA AC 3-6796	POLARIS	#	C	MICROWAVE SYSTEMS	F. DANE		
PANORAMIC RADIO PRODUCTS, INC. 520 S. FULTON AVE. MOUNT VERNON, N.Y. OW 9-4600		#	E	TEST INSTRUMENTS	W. WU	B. SCHLESSEL	S. KLEINMAN
PARAGON TOOL DIE & ENGINEERING 11035 SUTTER AVENUE PACOIMA, CALIFORNIA EM 9-5437	TITAN	#	E	IMPELLERS, EXDUCERS, INDUCERS, TURBINE WHEELS	P. REGAN	H. SAIVAR	D. FRANCE
PARAPLEGICS MFG. CO., INC. 10008 FRANKLIN AVENUE FRANKLIN PARK, ILLINOIS GL 5-1097	JUPITER	# # #	B A C	SMELTER CONTROLS AND CABLES CONTROLS & CABLES TIMERS	C. AUGUSTINE C. AUGUSTINE I. PRGBLR	F. HALEY F. HALEY F. HALEY	A. ENGLE A. ENGLE A. ENGLE
PARKER SEAL COMPANY 10567 JEFFERSON BOULEVARD CULVER CITY, CALIFORNIA VE 9-1161	MERCURY	#		SEALS FOR MERCURY, TITAN, THOR, ATLAS, SERGEANT, SNARK, TARTAR, TALOS, MINUTEMAN, NIKE	T. CARRELL	J. WENZELL	P. GLASSFORD
THE RALPH M. PARSONS CO. 617 W. SEVENTH AVE. LOS ANGELES, CALIFORNIA MA 9-2444		ELECTRONIC DIV. 191 S. DE LACY ST. PASADENA, CALIF. SY 5-7061	F	TELEMETRY & COMMUNICATION EQUIP	A. SMITH	P. DELVALLE	N. OGDEN
PARTS ENGINEERING COMPANY, INC. 760 N. MARSHALL AVENUE EL CAJON, CALIFORNIA HI 4-9441	TITAN	#	A	SEALS, COUPLINGS, FUEL LINE	E. PARR	B. MADDISON	C. HULL
	ATLAS	#		BELLOWS	SAME	SAME	SAME
PEARSON ELECTRONICS, INC. 707 URBAN LANE PALO ALTO, CALIFORNIA		#		ELECTRONIC COMPONENTS	P. PEARSON	M. STANGENES	P. PEARSON
PERKIN-ELMER CORPORATION NORWALK, CONNECTICUT VI 7-2422	MERCURY	#	C	PERISCOPES	J. SHANLEY		
	JUPITER	#	D	THEODOLITES	SAME		
	THOR	#	E	THEODOLITES	SAME		
	ATLAS	#	E	THEODOLITES	SAME		
	MACE	#	E	THEODOLITES	SAME		
	NEGULUS	#	C	THEODOLITES	SAME		
	MATADOR	#	C	THEODOLITES	SAME		

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000 C—$100,000—$500,000 E—$1 —$10 million G—$25—$50 million I—$75 —$100 million K—Over $250 million
B—$50,000—$100,000 D—$500,000—$1 million F—$10—$25 million H—$50—$75 million J—$100—$250 million

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
PHILCO CORPORATION 4700 WISSAHICKON AVENUE PHILADELPHIA 44, PENNA. VI 3-4000	STDEAINDER	GOVT'S INDUST.DIV.		GUIDANCE AND CONTROL SYS. AUTO. TEST. EQUIP.	N. JOHNSTON	J. LAGORE	J. MCALLISTER
	IRRIER	SAME		FUZE	S. SPIELMAN	SAME	SAME
	TARTAR	SAME		SAME	SAME	SAME	SAME
	TALOS	SAME		SAME	SAME	SAME	SAME
	CORPORAL	SAME		SAME	SAME	SAME	SAME
	SERGEANT	SAME		SAME	SAME	SAME	SAME
	LITTLE JOHN	SAME		SAME	SAME	SAME	SAME
	REDEYE	SAME		GUIDANCE AND CONTROL SYS.	SAME	SAME	SAME
	FALCON	SAME		FUZE	SAME	SAME	SAME
PIONEER PARACHUTE COMPANY, INC. 168 FOREST STREET MANCHESTER, CONNECTICUT MI 9-5211	SWALLOW	#	E	PARACHUTE SYSTEMS RECOVERY SYSTEMS	E. GIMALOUSKI	W. BELL	J. SCHUMACHER
	MACE MISC.CLASSIFD	#	D	SAME RECOVERY SYSTEMS	E. GIMALOUSKI SAME	B. SCHUBERT SAME	C. SCHUMAINEK SAME
PLANNING RESEARCH CORPORATION 1333 WESTWOOD BOULEVARD LOS ANGELES 24, CALIF. BR 9-7775	SAMOS	#	C	DATA HANDLING	A. BYLLY		
	POLARIS	#	C		H. KARR		
	SPEWS ECM	#	C	COUNTERMEASURES	R. HOWARD		
PNEU-HYDRO VALVE CORPORATION 52 HORSE HILL ROAD CEDAR KNOLLS, NEW JERSEY JE 8-7400		#		HYDRAULIC & PNEUMATIC COMP	W. BERGMANN	J. KAUP	H. DEMMERT
POLARAD ELECTRONICS CORP. 33-10 QUEENS BLVD. LONG ISLAND CITY, N.Y. EX 2-4500	VANGUARD	#		GROUND HANDLING EQUIPMENT			
	LACROSSE	#		CALIBRATION EQUIPMENT			
	MATADOR	#		SWITCH TESTER			
	MACE	#		SAME			
	ATLAS	#		BEACON TEST			
	NIKE-ZEUS	#		AUTOMATIC SIGNAL GENERATOR			
POLY-SCIENTIFIC CORPORATION BLACKSBURG, VIRGINIA PR 2-8212		#	D	BRUSH ASSEMBLIES, COMMUTATORS & SWITCHES			
POWER SOURCES, INC. BURLINGTON, MASS. BR 2-3610	TITAN	#	B	POWER CONVERTERS	R. SMYTH	S. GOLEMBE	P. GERMAINE
	ATLAS	#	A	SAME	SAME	SAME	SAME
	HONEST JOHN	#	A	TEST POWER SUPPLIES	SAME	SAME	SAME
PRECISION CASTPARTS CORPORATION 4600 S. E. HARNEY DRIVE PORTLAND 6, OREGON PR 5-4391		#	C	INVESTMENT CASTINGS	E. COOLEY	C. PAGE	K. PIERCE
PRECISION LAPPING CO., INC. 34 CLINTON AVENUE VALLEY STREAM, NEW YORK LO 1-2770	STDEAINDER	#	A	BRAKES	M. LIPKINS	S. LIPKINS	G. DIETZ
PRECISION SCIENTIFIC COMPANY 3737 WEST CORTLAND STREET CHICAGO 47, ILLINOIS CA 7-2660	POLARIS	#	A	GYRO CABINETS	A. KEITH	E. SCHROEDER	E. BLOSS
PRECISION THERMOMETER & INST. CO. 1403 BRANDYWINE STREET PHILADELPHIA 30, PENNA. LO 3-6671	THOR	#		DENSITROL	R. HEINMANN	H. HAUGH	I. SCHUBIN
PRATT AIRCRAFT COMPANY HOLLEY AND MADISON STREETS CLIFTON HEIGHTS, PENNA. MA 6-6500	ARCAS	#	A	NOSE CONE	M. BISHOP	F. DUER	R. NEAL
	TERRIER	#	A	BLAST TUBE INSULATION	M. BISHOP	E. MOORING	R. NEAL
PULSE ENGINEERING 560 ROBERT AVENUE SANTA CLARA, CALIF. CH 8-6080		#	E	PULSE TRANSFORMERS WAVE FILTERS	R. ROWE	J. SHIPE	R. KNIGHT

Q

QUALITY CONTROL CORP. 7313 WILSON AVE. CHICAGO 31, ILL. UN7-9200	BOMARC	#		HYDRAULIC & PNEUMATIC VALVES	J. LITTLE	W. CARNEY	R. NICHALEK
	TALOS	#		SAME	SAME	SAME	SAME
	NIKE	#		SAME	SAME	SAME	SAME
QUANTUM, INC. LUFBERY AVE. WALLINGFORD, CONN. CO9-7765		#	C	PROPELLANTS	A. PRENNINGER W. VAUGHAN		
QUTRONIC TRANSFORMER CORP. 525 BROADWAY NEW YORK 12, N.Y. 202-3639		#	C	TRANSFORMERS, AMPLIFIERS	M. LUCK	E. LOGANOFF	A. LOMASCOLO

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
				R			
RCA 30 ROCKEFELLER PLAZA NEW YORK 20, N.Y. COS-5900	SATELLITES	RCA-ASTRO-ELECTRONIC BOX 800 PRINCETON, N.J. #AR-2700		COMPLETE SPACE SYSTEMS & SUBSYSTEMS & SUPPORTING GROUND BASED EQUIPMENT			
	JUPITER	AIRBORNE SYSTEMS DEPT. FRONT & COOPER STS. CAMDEN 2, N.J. #0 3-8300		INSTRUMENTATION			
	TALOS L TERRIER I SCAL THOR ATLAS LITTLE JOHN	SAME SAME SAME SAME SAME MIS. & SUR. RAD. DEPT. MARNE WAY & BORTON LDG. MOORESTOWN, N.J.		GUIDANCE & LAUNCHER DEVELOPMENT GUIDANCE COMPONENTS GROUND CHECKOUT EQUIPMENT INSTRUMENTATION STUDY & EVALUATION			
	NIKE-ZEUS DYNA-SOAR POLARIS NIKE-ZEUS ATLAS JOMARC MINUTEMAN PERSHING DEFENDER	SAME SAME AIRBORNE SYS. DEPT. MIS. ELEC. CON. DEPT. BURLINGTON, MASS. MIS. & SUR. RAD. DEPT. SAME DEF. ELEC. PROD. DEPT.		RADAR DEVELOPMENT COMMUNICATIONS SYSTEMS GUIDANCE SATELLITE INTERCEPTOR SYSTEM LAUNCH CONTROL SYSTEM RADAR TRACKING ELECTRONIC SUB-SYSTEMS AIRBORNE TV CAMERAS TRACKING RADAR			
ROC MANUFACTURING CO. 585 MAIN ST. EAST ORANGE, N.J. OR3-4464	"		D	GROUND SUPPORT EQUIPMENT	F. SNYDER	T. BOYS	W. O'CONNOR
R S ELECTRONICS CORP. 435 PORTAGE AVE. PALO ALTO, CALIF. DA1-1130	" " " " RP-76		B C " C	GUIDANCE RADIO-COMMAND RADAR EQUIPMENT CONVERTER AMPLIFIERS	C. LINDSETH C. LINDSETH J. ISABEAU W. BURTON C. LINDSETH		R. PARKS R. PARKS R. PARKS R. PARKS R. PARKS
RADAR RELAY, INC. SANTA MONICA, CALIF. EX4-2230	POLARIS	"	C	AORD WARNING SYSTEM	K. KUHN		D. SULLIVAN
RADIAL BEARIN CORP. TAYLOR ST. DANBURY, CONN. PI8-2577		" " ~	D	TEFLON-FABRIC BEARINGS & ROUNDS	H. KRAVATS	L. PAPISH	L. PAPISH
RADIAPHONE COMPANY, INC. 600 EAST EVERGREEN AVE. MONROVIA, CALIF. EL8-2565	TERRIER TARTAR NIKE ATLAS	" " " "	E	SHIPBOARD TELEMETRY FOR TERRIER, TARTAR, TALOS AIRBORNE TELEMETRY SAME CABLES TRANSIT CASE GROUND SUPPORT	G. LISKA L. ROAN SAME SAME SAME	R. LORD R. LORD H. PARKMAN SAME SAME	H. ADAMS SAME SAME SAME SAME
RADIATION INC. MELBOURNE, FLA. PA3-1511	MINUTEMAN TITAN NIKE ZEUS ATLAS COURIER SAMOS BULLPUP TALLTOM PERSHING LACROSSE JOMARC NATAUR	ASTRIONICS DIV. ASTRIONICS DIV. " " ASTRIONICS DIV. " R.F. DIV. R.F. DIV. INSTRUMENT DIV. SAME SAME SAME SAME PRODUCTION DIV. RESEARCH DIV.	E E D E E C E E D	TELEMETRY SAME DATA PROCESSING ANTENNA SYSTEM SAME SIMULATORS CHECKOUT EQUIPMENT SAME SAME SAME TEST EQUIPMENT GUIDANCE STUDIES		F. CULLMAN	W. PHENAZA E. AZZIAL J. DIAZ R. DRUBAKER R. PENN W. SIMMONS G. CLINE J. SIMMONS SAME SAME J. TRUTTER
RADIATION RESEARCH CORP. 3114 FIRST AVE. NEW YORK 21, N.Y. TE8-2513		" "	D C	ELECTRONIC COMPONENT NUCLEAR PROPULSION	S. GRAND S. GRAND		M. RAY M. RAY
RAVEN INDUSTRIES INC. BOX 227 SIOUX FALLS, S. DAKOTA ED4-7566		"	B	ELECTRONIC SUBASSEMBLIES	D. THON	B. MUEHLER	J. FOSS
RAYDESTOS-MANHATTAN, INC. PASSAIC, N.J. GR3-2000	POLARIS MINUTEMAN SIDEWINDER TERRIER ARCAS BOLD ORION	REINFORCED PLAST. DEPT. MANHEIM, PA. MO5-2211 SAME SAME SAME SAME SAME		REINFORCED PLASTIC PARTS SAME SAME SAME SAME SAME	R. MOORE SAME SAME SAME SAME SAME	J. BLANCK SAME SAME SAME SAME SAME	F. MITZER SAME SAME SAME SAME SAME
RAYTHEON COMPANY FOUNDRY AVE. WALTHAM 54, MASS. TB9-8400	SPARROW III HAWK PINCUSION RADAR ICBM	MI SAME S DIV. 520 WINTER ST. WALTHAM, MASS. TB9-8000 SAME SAME SAME		COMPLETE SYSTEM SAME SAME STUDIES			
REDEL INCORPORATED ANAHEIM, CALIF. PR 4-3624		"	A	IGNITION R & D PROPELLANT STUDY IGNITION STUDY IGNITION R & D	E. GRABAU J. GILMORE C. NEWMAN D. VEST		C. YOUNG C. YOUNG C. YOUNG C. YOUNG

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
REEVES INSTRUMENT CORP. SARUEN CITY. NEW YORK P16-8100		#	D	FUZES —	S. FREEMAN		
	DISCOVERER	#		TRACKING RADAR	S. MEADOWS		
	DISCOVERER	#	E	ANTENNA PEDESTALS	T. OOSCH		
	MERCURY	#	E	TRACKING RADAR ANTENNA PED	S. MEADOWS		
	NIKE-ZEUS	#	C	PARALLAX COMPUTER	R. MAYER		
	POLARIS	#	E	GYROS	L. WEISNER		
	POLARIS	#	D	STABLE PLATFORM	F. SIMON		
	POLARIS	#	D	MULTI-SPEED REPEATERS	F. SIMON		
	DISCOVERER	#	E	INERTIAL REFERENCE PACKAGES GYROS FOR: TERRIER, BOMARC RESOLVERS & DIFFERENTIALS	L. KING		
REMANCO, INC. 1805 COLARADO SANTA MONICA, CALIF. EX 3-7184	POLARIS	#		POWER PLANT OPTICAL INSPECTION	F. GIBSON		I. COSMER
	GAR 6	#		REFERENCE RETICLES	A. RASSEY		SAME
REHLER COMPANY SAN FRANCISCO 10, CALIF. VA 6-3435		#	B	LAUNCH PAD & MISSILE ASSEMBLY	H. GREENE	J. FRETWELL	S. MOHN
REPUBLIC AVIATION CORPORATION FARMINGDALE, NEW YORK CH9-1100	SWALLOW	MINEOLA, NEW YORK	G	RECONNAISANCE DRONE	J. WAGNER	R. STEGLER	A. OWENS
	BULLPUP CE	SAME	D	R & D	D. SHINNER	SAME	SAME
	ATLAS & THOR	SAME	E	COMPONENTS	P. HIMKA	SAME	SAME
	ANTI-ICBM STUDIE	SAME	D	R & D	O. KRIEGER	SAME	SAME
REPUBLIC LENS CO., INC. 31 EAST 169TH ST. NEW YORK 52, N.Y. CY3-2790		#	A	OPTICAL AND ELECTRONIC INST	J. LUPIC	E. BACH	B. ROTHMAN
RESEARCH, INCORPORATED P.O. BOX 6164 MINNEAPOLIS 24, MINN. WE5-2156		#	E	HIGH TEMP. TEST FACILITIES	J. ANDERSON		G. GUTZUW
RESISTANCE WELDER CORP. 116 FIRST ST. BAY CITY, MICH. TW 3-9342		#	C	SPECIAL WELDING EQUIPMENT	R. WIGHT	J. NICHOLS	T. VALLAIRS
RESISTOFLEX CORPORATION ROOSELAND ROAD ROSELAND, N.J. CA 6-7770	CORVUS	SOUTHWEST, DIV. BOX 10187 DALLAS, TEX. RI 2-2396	A	FUEL & HYD. SYSTEM COMPONENTS	C. COZZENS	R. MANNING	J. ZUCKER
	REGULUS	SAME	B	GND. SUPPORT	SAME	SAME	SAME
	ATLAS	SAME	B	GND. SUPPORT	SAME	SAME	SAME
J.E. REX COMPANY 5TH & FRANCONIA AVE. LANSDALE, PA. UL5-1131	POLARIS	#		ENGINE CHAMBERS & NOZZLES	T. FERGUSON	J. WEISSER	J. KING
	MINUTEMAN	#		SAME	SAME	SAME	SAME
	PERSHING	#		ENGINE CASE	SAME	SAME	SAME
	SNARK	#		NOZZLES	SAME	SAME	SAME
	BOMARC	#		HEADS	SAME	SAME	SAME
ROBBINS AVIATION, INC. LOS ANGELES 58, CALIF. LU 9-5221		# #	D	VALVES, DEHYDRATION EQUIPMENT	J. CLARK	J. SHAY	R. BIXLER
ROBERTSHAW-FULTON CONTROLS CO. ANAHEIM, CALIF. KE 5-8151	ATLAS	AERO & INST. DIV. ANAHEIM, CALIF.	E	AIRBORNE HELIUM REGULATORS	W. THOMPSON	W. THOMPSON	W. THOMPSON
	TITAN	SAME	E	AIRBORNE HELIUM REGULATORS	S. SHANNON	H. CHASE	H. CHASE
	TITAN	SAME	C	AIRBORNE HELIUM REGULATORS	S. SHANNON	S. SHANNON	S. SHANNON
		SAME	C	PHASE MULTILOK	T. TOBIAS	C. CRAFTS	W. WHITE
		SAME	E	HELIUM REGULATORS	G. SCHATZMAN	H. CHASE	H. CHASE
	DISCOVERER	SAME	C	HELIUM REGULATORS	J. EVANS	H. CHASE	H. CHASE
	ATLAS	SAME	C	PNEUMATIC GROUND SUPPORT	E. CLARK	J. LIPTAK	W. RULE
	ATLAS	SAME	E	HELIUM & LOX DISCONNECTS	G. SCHATZMAN	C. ANLIKER	L. MOLONEY
	TITAN	SAME	D	DISCONNECTS	G. SCHATZMAN	C. ANLIKER	L. MOLONEY
ROLLE MFG. 317 CANNON AVE. LANSDALE, PA. UL 5-1171	NIKE	#		GROUND SUPPORT			
RONAN & KUNZL, INC. S. KALAMAZOO AVE. MARSHALL, MICH. ST1-2861		#	C	LIQUID OXYGEN CONTAINERS	H. HAURER	C. MORGAN	J. LAWLER
RONSON HYDRAULIC UNITS CORP. 1313 LINCOLN AVENUE PASADENA, CALIF. MU 1-0221	NIKE-ZEUS	#		HYDRAULIC ACCUMULATORS	D. TOBIAS	I. ABERSON	H. BOLTZ
	BOMARC	#					
	NIKE-HERCULES	#					
ROSEMOUNT ENGINEERING CO. 4900 W. 78TH ST. MINNEAPOLIS 24, MINN. WA7-7711	THOR	#	A	TEMPERATURE TRANSDUCERS	R. KEPPEL	G. CHURCH	H. BOQUIST
		# #					
	ATLAS	#		SAME	SAME	SAME	SAME
	JUPITER	#		SAME	SAME	SAME	SAME
	DYNA-SOAR	#		SAME	SAME	SAME	SAME
	NIKE-ZEUS	#		SAME	SAME	SAME	SAME
	TITAN	#		SAME	SAME	SAME	SAME
ROTARY DEVICES CORPORATION 40 JAY STREET ENGLEWOOD, N.J. LO 9-0433	PERSHING	#	A	SWITCHES	L. SILVAN	H. BUENO	W. WELBY
		#					
		# #					
	HAWK	#	A	COUNT DOWN EQUIPMENT	SAME	SAME	SAME
	NIKE-ZEUS	#	A	SLIP RINGS	SAME	SAME	SAME

*Code for Approximate Contract Dollar Value

A — $10,000 — $ 50,000	C — $100,000 — $500,000	E — $1 — $10 million	G — $25 — $50 million	I — $75 — $100 million	K — Over $250 million	
B — $50,000 — $100,000	D — $500,000 — $1 million	F — $10 — $25 million	H — $50 — $75 million	J — $100 — $250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
ROTATING COMPONENTS, INC. BROOKLYN 22, N.Y. EV9-3490	POLARIS	#	C	FRACTIONAL HP MOTORS	M. HAYDEN	A. G. MILLER	J. H. MILLS
	ATLAS	#		SAME	SAME	SAME	SAME
	MACH	#		SAME	SAME	SAME	SAME
ROYAL INDUSTRIES, INC. 1035 WESTMINSTER AVE.	ASROC	ROYAL JET DIV. 1035 WESTMINSTER AVE.	C	PAYLOAD CONTAINER	F. SKERY	E. JOHNSON	A. NESTER
	TERRIER	SAME	B	BOOSTER FIN CONTAINER	L. STONE	E. JOHNSON	A. NESTER
	BOMARC	SAME	C	RAMJET ENGINE CONTAINER	G. KEEVER	E. JOHNSON	A. NESTER
ROYAL MCBEE CORPORATION WESTCHESTER AVE. PORT CHESTER, N.Y. WE7-3000		DEFENSE PROD. DIV. 1700 WISCONSIN AVE. WASHINGTON, D.C.		COMMUNICATIONS AND DATA PROCESS	C. SHINN		S. BROMFILED
		INSTRUMENT DEVEL. LAB. ATTLEBORO, MASS.		TELEMETERING, CONVERTERS, GUIDANCE, ACCELEROM	E. LEWIS	P. SAMUELSON	W. PENDERGAST
THE RUCKER COMPANY 4700 SAN PABLO AVE. OAKLAND 8, CALIF. OL3-5221	BOMARC	#		LAUNCHER HYDRAULIC COMPONENTS			
	ATLAS	#		LAUNCH SITE HYD. & PNEUMATIC EQ			
	POLARIS	#		TEST EQUIPMENT			
	MINUTEMAN	#		CENTRIFUGE ACCELERATION TEST EQ			
	TITAN	#		SAME			
RUSSELL REINFORCED PLASTICS CORP. 521 W. HOFFMAN AVE. LINDENHURST, L.I., N.Y. TU4-1700		#	G	NOSE CONES	J. TURNER	W. AMENDOLA	J. SCHOEPFER
THE RUTHMAN MACHINERY CO. 1813 READING RD. CINCINNATI 2, OHIO MA1-5462		#	D	PUMPS	J. RUTHMAN	J. SMITH	A. RUTHMAN
RYAN AERONAUTICAL COMPANY HARBOR DRIVE SAN DIEGO, CALIF. CY 6-6691		ELECTRONICS DIV. 2750 W. LOMITA BLVD. TORRANCE, CALIF. DA 6-9520	G	NAVIGATION SYSTEMS	P. LINEBERGER	W. BATES	M. WILSON

S

SAFEWAY HEAT ELEMENTS, INC. MIDDLEFIELD ST. MIDDLETOWN, CONN. DI 6-6601		#	C	COMPONENTS	B. MOORE	R. BELLS	J. O'ROURKE
SANCOR CORPORATION, DIV. SIEGLER CO 1661 FRANKLIN AVE. EL SEGUNDO, CALIF. OR 8-5069	CENTAUR	#	A	GROUND SUPPORT	C. ROSEMAN	A. LEWIS	A. KNIGHT
	ATLAS	#		SAME	SAME	SAME	SAME
	THOR	#		SAME	W. POZNIK	SAME	SAME
	NIKE	#		SAME	SAME	SAME	SAME
	SATELLITE	#		SAME	SAME	SAME	SAME
SANDIA CORP. ALBUQUERQUE, N.M.	CORPORAL	#		WARHEAD SYSTEM CONTROL			
	HONEST JOHN	#		SAME			
	LITTLE JOHN	#		SAME			
	TALOS	#		FUSE, WARHEAD SYSTEM CONTROL			
	TARTAR	#		SAME			
	TERRIER	#		SAME			
	ATLAS	#		FUSE			
	THOR	#		SAME			
	TITAN	#		WARHEAD			
SAVAGE-ROWE PLATING CO. KALAMAZOO, MICH. FI 5-0532		#	C	PLATING & ELECTROFORMING	C. BOMMERSCHEIM	F.K. SAVAGE	M. SAVAGE
SCHELLENS-TRUE CORPORATION IVORYTON, CONN. SO 7-8248	HAWK	#		APU TURBINE WHEEL	E. P. SCHELLENS	R. BLACK	
	SPARROW	#		SAME	SAME	SAME	
SCHAFFER AIR INDUSTRIES, INC. BROOKLYN 22, N.Y. EV 3-5300		#	C	TESTERS, TEST SETS	B. SCHAFFER		
G. F. SCHUELDAHL COMPANY NORTHFIELD, MINN. NI 5-5635	ROBIN	#	C	ROCKET BALLOON INSTRUMENT	R. SLATER	R. PETERSON	L. STOUTLAND
	ECHO	#	A	100' SPHERES SATELLITE	R. SLATER	R. SCHAEFFER	L. STOUTLAND
SCIENTIFIC-ATLANTA INC. ATLANTA, GEORGIA TR 5-7251		#	C	ANTENNA SYSTEM	H. FILMER	M. HARRIS	J. RAY
		#	C	RETANGULAR PATTERN RECORDERS	C. CRADDOCK	M. HARRIS	G. RAY
			C	ANTENNA SYSTEM	H. DEAN	M. HARRIS	G. RAY
SEALOL CORP. PROVIDENCE 9, R. I. ST 1-4700	POLARIS	#	A	MECHANICAL SEALS	F. BUSSICK	E. JNDERHILL	
	DYNA-SOAR	#		SAME	SAME	SAME	
	BOMARC	#		SAME	SAME	SAME	
	VANGUARD	#		SAME	J. SWAN	SAME	
	TITAN	#		SAME	N. JOHNSON	SAME	
	ATLAS	#		SAME	N. JOHNSON	SAME	
	MINUTEMAN	#		SAME	F. BUSSICK	SAME	
SEAMAN PAPER CO. 1235 SHERMAN EVANSTON, ILL.		SEAMAN PROD. DIV. 13001 BRADLEY AVE. SYLMAR, CALIF. EM 7-1881	B	HIGH TEMPERATURE INSULATION	D. SEAMAN	M. DICE	D. DRUSCH

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000 C—$100,000—$500,000 E—$1 —$10 million G—$25—$50 million I—$75 —$100 million K—Over $250 million
B—$50,000—$100,000 D—$500,000—$1 million F—$10—$25 million H—$50—$75 million J—$100—$250 million

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
SIMPSON OPTICAL MFG. CO. 3200 WEST CARROLL AVE. CHICAGO 44, ILL. VA 6-3030	SIDEWINDER	"		OPTICAL COMPONENTS	E. BICKELL	W. STRICKLAND	W. WISSER
SHAW & ESTES, INC. 1407 S. AKARD ST. DALLAS, TEXAS RI 1-4924		"	E	FACILITIES CONSTRUCTION	R. NELSEMAN	W. LAGE	R. MITCHELL
SKIATRON ELECTRONICS AND TELEVISION 180 VARICK ST., NEW YORK 14, N. Y. WA 4-7060		"	C	DISPLAY	E. CULBERTSON		N. ACKERMAN
SKYJYNE, INC. RIVER ROAD PORT JERVIS, N. Y. 3-2241	HAWK	"	D	RADAR CONSOLE	G. PARSONS	M. KANTOR	B.E. MANCHANT
SLIP RING COMPANY OF AMERICA 3612 W. JEFFERSON BLVD., LOS ANGELES 16, CAL. RE 5-0253		"	D	SLIP RINGS & BRUSHES	R. WOLFE	G. GORDON	R. ANDERSON
SMALL MOTORS INC. CHICAGO 14, ILLINOIS AR 6-6900		"	D	FRAC. HP MOTORS BLOWERS GENER	R.R. COOK		
A. O. SMITH CORPORATION	FALCON	AERONAUTICAL-WESTERN DIV. 900 E. BALL RD. ANAHEIM, CAL. PR 4-2600	D	PNEUMATIC LAUNCHERS	R. L. GREEN	A. CODDING	T. SMITH
MILWAUKEE, WISCONSIN UP 3-3000	POLARIS	SPECIAL PRODUCTS & TOOL MILWAUKEE, WIS. UP 3-3000		MISSILE CHAMBERS	N. SHERWOOD		
	TITAN	SMITH-ERIC DIV. P.O. BOX 559 ERIE, PA. TA 9-3134		FUELING EQUIP.	H. SMITH		
SODERBERG MFG. CO., INC. 628 S. PALM AVE. ALHAMBRA, CALIF. CU 3-3382		"	C	ELECTRONIC COMPONENTS	H. GIBBONS	C. DESIMONE	W. LEE
SOLAR AIRCRAFT COMPANY SAN DIEGO, CAL. BE 3-8241	MINUTEMAN	"		ROCKET MOTOR CASES & NOZZLES			
	ARCAS	"		SAME			
	POLARIS	"		SAME			
	ATLAS	"		SAME			
	THOR	"		ENGINE MOUNTS			
	LACROSSE	"		GROUND SUPPORT NOSE CONE			
	THOR	"		FUEL EXPANSION JOINTS			
	TITAN	"		SAME			
	ATLAS	"		SAME			
				SATELLITE INTERCEPT SUBSYSTEM			
SOLRAC INC. 11760 VOSE ST., NO. HOLLYWOOD, CAL. PO 5-9867		"	D	VALVES	C. REP	C. STEIN	E. GOSCO
SOUTH. CALIF. COOP. WIND TUNNEL-C.I.T. 950 S. RAYMOND AVENUE PASADENA, CALIF. HU 2-2183	NIKE	"	D	AERODYNAMIC TESTING	F. FELSCH	P. KELLER	W. BAYLEY
SOUTHWESTERN INDUSTRIAL ELECTRONIC 10201 WESTHEIMER ROAD, HOUSTON 27, TEXAS. HO 5-3471	PERSHING	"	D	SIGNALCONDITIONING EQUIP	JOE YATE	WM. O'CONNOR	
	POLARIS	"		POWER SUPPLIES	J.W. FRATH	SAME	
	SUBROC	"	C	AIRBORNE AMPLIFIERS	F. MC KEE	SAME	
				POWER SUPPLIES	YATE	SAME	
SPACE TECHNOLOGY LABORATORIES, INC. 5500 EL SEGUNDO BLVD., EL SEGUNDO, CALIF. OS 5-4677	ATLAS	"		SYSTEMS DEVELOPMENT			
	MINUTEMAN	"		SAME			
	THOR	"		SAME			
	TITAN	"		SAME			
SPECIAL DEVICES, INCORPORATED 12300 MONTAGUE STREET, PACOIMA, CALIF. EM 9-2595	NIKE HERCULES	16830 PLACERITA CYN. NEWHALL EM 52580	C	PRACTICE WARHEAD SEPARATION	G. BOOTHROY	K. JOLE	J. DESALVO
	FALCON	SAME		FUZES INFRARED AND TRACKING	J. MCCLUNE	F. SNYDER	R. NELSON
	COURIER & TRANSIT	SAME	A	SEPARATION SYSTEM	H. ROSENTHAL	SAME	SAME
	POGO-HI	"	A	TRACKING FLARES	J. MCCLUNE	F. SNYDER	B. NELSON
		12300 MONTAGUE PACOIMA, CAL. EM-92589					
	LOKI	SAME	A	IGNITERS	A. LYTLE	K. JOLE	J. DESALVO
	NIKE-ASP	SAME	B	PRACTICE WARHEAD	G. BOOTHROY	SAME	SAME
	SERGEANT	SAME		DESTRUCT SYSTEM IGNITERS	A. LYTLE	F. SNYDER	SAME
	FIREBEE	SAME		INFRARED AUGMENTATION	J. MCCLUNE	K. JOLE	B. NELSON
	CORVUS	SAME	A**	TRACKING FLARE	H. ROSENTHAL	K. JOLE	R. NELSON
	POLARIS	SAME	C		A. LYTLE	F. SNYDER	J. DESALVO
	GENIE	SAME	"		G. BOOTHROCK	K. JOLE	SAME
SPEC TOOL CO. 9626 E. BEVERLY ROAD, PICO RIVERA, CALIF. RA 3-7530	THOR	"	B				
	MERCURY	"	A	TOOLS ADJUSTABLE SLIMS			
SPECIALTIES, INC. SKUNKS MISERY RD., SYOSSET, N. Y. WA 1-2345	BOMARC	"		TRANSDUCERS	D. CAHILL	C. BELL	G. CHADWICH
				SAME	SAME	SAME	SAME
	GREEN QUAIL	"		SAME	SAME	SAME	SAME
	SWALLOW	"	B				

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
SPERRY RAND CORPORATION NEW YORK 20, N. Y. CI 6-4800	TERRIER	SPERRY GYROSCOPE DIV GREAT NECK, L.I., N.Y. FI 7-3600		GUIDANCE RADAR			
	TALOS	SAME		SAME			
	JUPITER	SAME		GUIDANCE & CONTROL			
	POLARIS	SAME		TEST LAUNCHERS & GUIDANCE			
	SERGEANT	SPERRY UTAH ENGRG. LAB. SALT LAKE CITY, UTAH		AIRFRAME			
	TARTAR	SAME		RADAR			
	RQ-4A	SAME		COMMAND GUIDANCE			
	TITAN	ELECTRONIC TUBE DIV. GAINESVILLE, FLA.		GUIDANCE			
	NIKE-ZEUS	SPERRY GYRO DIV. GREAT NECK, L.I., N.Y. FI 7-3600		AMPLIFIERS			
	LITTLE JOE	SAME		GUIDANCE			
	TITAN	SAME		ELECTRONIC COMPONENTS			
SPERRY GYROSCOPE COMPANY, DIV. SPERRY GREAT NECK, L.I., N.Y. FI 7-3600	POLARIS	" MARINE DIVISION SYOSSSET, N.Y.		SINS	F. BRADDON	H. STURN	L. BISCHER
	TERRIER	" SURFACE ARM. DIV. GREAT NECK, N.Y.		TRACKING AND GUIDANCE	N. CASTAGLIOLA	S. SIEGEL	C.A. BROWN
	TALOS	"		TRACKING AND GUIDANCE	S.O. NEUMAN	W. KUEHNLE	C.A. BROWN
STANDARD ARMAMENT INC. 631 ALLEN AVENUE, GLENDALE, CALIF. VI 9-1314	SPARROW	"		LAUNCHERS	R. CORNELL	C. CORRELL	C. CORRELL
STANDARD STEEL CORP. LOS ANGELES, CALIF.	THOR	" CAMBRIDGE DIVISION LOWELL, MASS.	E	LOX FUELING TANKS	D. WILLIAMS	C. KINNEHEIMER	J. MCARDLE
	ATLAS	SAME		LOX AND FUEL TRANSFER SYSTEMS	R. JOHNSON	C. MITCHELL	J. MC ARDLE
	TITAN	"		LOX RECHARGER TRAILERS	ROISVERT	C. KINNEHEIMER	H. PRATT
	TITAN	"		LOX & FUEL TANKS			
STATOR ELECTRIC CORP. LONG ISLAND 1, N.Y. EM 1-2080		"	C	STATORS ROTORS MOTOR COMP	P. STUDNER		
		"					
STERLING PRECISION INSTRUMENT CORP. CAMBRIDGE, MASS. UN 4-8130	POLARIS	"	C	GYRO, TEST EQUIPMENT	J.J. JAROSH	G. BROWNING	T.C. TAJER
	THOR	"	C	SAME	SAME	SAME	SAME
	ATLAS	"	C	SAME	SAME	SAME	SAME
	TITAN	"	C	SAME	SAME	SAME	SAME
	BOMARC	"		SAME	SAME	SAME	SAME
STEWART-WARNER CORPORATION 1514 DROVER STREET, INDIANAPOLIS 7, IND. ME 2-8411	ATLAS	SAME	C	LOX CONTROLS	J. PARMERLEE	B. ROSSMAN	P. OSTLER
	BOMARC	SO. WING DIV.	D	ELECTRONIC COOLING	D. HOLLCROFT	B. ROSSMAN	P. OSTLER
	NAVAHO	SAME	A	ELECTRONIC COOLING	SAME	SAME	SAME
	HOUND DOG	SAME	B	ELECTRONIC COOLING	J. PARMERLEE	SAME	SAME
	CE	SAME	A	WATER SEPARATOR	D. HOLLCROFT	SAME	SAME
	MACE	SAME		SAME	SAME	SAME	SAME
	MINUTE MAN	SAME		MAGNESIUM EXCHANGER	SAME	SAME	SAME
	ATLAS	SAME	D	LOX VALVE & CONTROLLER	J.K. PALMERLEE	SAME	SAME
STEWART STEVENSON SERVICES, INC. 4516 HARRISBURG HOUSTON, TEXAS. CA 5-5341	MIKE	"	E	GROUND POWER UNIT	R. MITCHELL	D. METCALF	H. PARKER
	TERRIER	"	D	SAME	SAME	SAME	SAME
	HAWK	"		SAME	SAME	SAME	SAME
STRUTHERS WELLS CORP. TITUSVILLE, PA. 5-3211			E	HIGH PRESSURE VESSELS	C. LONG	R. OTTAWAY	P. STEGER
STUDEBAKER-PACKARD CORP. 635 S. MAIN ST., SOUTH BEND 27, IND.	PERSHING	CTL DIV. 1240 GLENDALE CINCINNATI, OHIO PR 1-3200	A	RE-ENTRY VEHICLE	R. NEWBOLD	M. KORELITZ	
	JUPITER	SAME	E	SAME	N. BERGER	SAME	
	MERCURY	SAME		SAME	J. WINTER	SAME	
SUMMIT INDUSTRIES, INC. GARDENA, CALIF. FA 1-3412	TRANSIT	"	A	PLASTIC FAIRINGS	R. MATLOCK	I. GREEN	S. PHILLIPS
	COURIER	"		SAME	SAME	SAME	SAME
	ATLAS	"		SAME	SAME	SAME	SAME
SUN DIAL CORPORATION P. O. BOX 326 CALDWELL, N.J. CA 6-4331		"	C	PANELS, CONSOLES FOR ATLAS, POLARIS, HAWK	A. KARKER	S. LEATHERBERRY	M. CALLOWAY
SUN ELECTRIC CORPORATION HARLEM & AVONDALE AVENUES, CHICAGO 31, ILLINOIS. NE 1-6000	TITAN	"		HYD. CONSOLES	F. BRAUER	H. SMINE	R. KANE
		"		NI-CAD BATTERY CHARGERS			
	BOMARC	"		HYD., PNEU., ELECT. CONSOLE	SAME	SAME	SAME
	SNARK	"		ENGINE DRIVEN HYD. CONSOLE ELECT. LOAD BANK	SAME	SAME	SAME
SUNDSTRAND AVIATION DIV. 2421 11TH ST. ROCKFORD, ILL. RO 8-6611	BOMARC	DENVER DIV. 2480 W. 70TH ST. DENVER, COLO. HA 9-1361	C	HYDRAULIC MOTOR	R. HALL		
	HOUND DOG	SAME	C	CONSTANT SPEED MOTOR	SAME		
	TITAN	SAME TURBO DIV. 10845 GLADIOAKS RD. PACOIMA, CALIF. EM 6-0121	C	GYRO EQUIPMENT SYSTEMS ASD			
	SNARK	"	C	CONSTANT SPEED DRIVE	F. FARIS		
SUPERWELD CORP. 6840 VINELAND AVE., NO. HOLLYWOOD, CAL. TR 7-3121		"	D	HYD. CYLINDERS, SOLENOIDS	K. MADDEN	W. BRADLEY	R. OMANS
SYSTEMS RESEARCH MINEOLA BLVD. MINEOLA, N.Y.		"		WEAPON SYSTEM EVALUATION	M. LIEBOWITZ O. FRY F. LEVINE		

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
SYLVANIA ELECTRIC PRODUCTS 1740 BROADWAY NEW YORK 19, N. Y. JU 6-2424	POLARIS	SEMICONDUCTOR DIV. 100 SYLVAN ROAD WOBURN, MASS. 40 2-3500		MICROWAVE DIODES			
	ATLAS			TRANSISTORS			
	TARTAR	SYLVANIA LIGHTING PROD. COIL & TRANSFORMER PLANT IPSWICH, MASS. IP 260		TRANSFORMERS FOR BOMARC, FALCON, SPARROW, TALOS, NIKE			
	SIDEWINDER	SAME		MISSILE HEAD			
	PLATO	SYLVANIA ELECTRONIC SYSTEMS 100 FIRST AVE. WALTHAM, MASS. TW 3-9200		AIRFRAME			
		SYLVANIA ELECTRONIC TUBES EMPORIUM, PENNA. EM 301		RECEIVING TUBES FOR: BOMARC, MATADOR, REDSTONE, REGULUS, MAGNETRONS FOR BOMARC, TRANSMITTERS FOR LACROSSE, HASCAL, REGULUS, SPARROW			
		SPECIAL TUBE OPERATIONS— 500 EVELYN AVE. MOUNTAIN VIEW, CAL. YO 7-8981		SPECIAL WIRE			
	VANGUARD	PARTS DIVISION WARREN, PENNA. 4A 3220		COMMUNICATIONS			
	POLARIS	SEMICONDUCTOR DIV. 100 SYLVAN ROAD WOBURN, MASS. 40 2-3500					
SYSTRON CORP. 950 CALINDO ST. CONCORD, CALIF. MU 2-3650		#	C	ELECTRONIC INSTRUMENTS & SYS	N. PERLMITTER	M. TORPACKA	D. TORPACKA
T							
TRG, INC. SYOSSET, L.I., N.Y. OV 1-6900	GUSTO	#		RADOMES	J. KATIK	J. HAIMAN	J. RUSINAK
		#		GUIDANCE, OSCILLATORS	D. CHASE	L. GOLDMUNTZ	SAME
		#		GAS CELL MASER	G. GOULD	SAME	SAME
		#		LASER	R. DALY	SAME	SAME
		#		OBSTACLE SENSING	W. GRAHAM	SAME	SAME
TANSITOR ELECTRONICS, INC. WEST ROAD BENNINGTON, VERMONT 5473		#	C	TANTALUM CAPACITORS	R. RUSS	C. LAPIERRE	G. GREEN
TAYLOR ELECTRIC INC. 15430 DALE AVENUE DETROIT 23, MICH. KE 5-2500		#	A	WIRING DUCTS FOR JUPITER, TITAN, ATLAS	P. TAYLOR	J. HOWE	R. TAYLOR
TAYLOR FIBRE CO. BOX 471 NORRISTOWN, PA. GL 2-2811				NOSE CONE MAT. FOR POLARIS, SIDEWINDER, HARK, SPARROW, TITAN	G. MULLER	R. HYDEMAN	H. FIFER
		1400 PALOMARES AVE.		MOTOR CASES FOR BOMARC, FALCON, SERGEANT, ATLAS, NIKE, JUPITER	E. GUELPA	P. BROWN	
TECHNICAL OIL TOOL CORPORATION 1067 NORTH LA BREA AVE. LOS ANGELES 38, CALIF. OL 4-1763		#	C	ATTENUATORS, TIMERS, PROGRAMS TUNERS, R.F.	O. SUTER	W. GREEN	S. HOPGAN
TEKTRON INSTRUMENT CO. HILLSBORO, OREGON MI 8-3123		#	A	HARNESS ASSYS. FOR TITAN	R. HALL	W. KLOEPFER	J. COSTIGAN
		#	C	TEMPERATURE SENSING PROBES, MIN. CART. HEATERS	R. HALL	W. KLOEPFER	J. COSTIGAN
TELECHROME MFG. CORPORATION AMITYVILLE, NEW YORK LI 1-3600	POLARIS	#		TELEMETERING, ELECTRONIC COMP	H. SCHMID	H. ALBAUM	R. TRIMBOLI
	ATLAS	#		SAME	SAME	SAME	SAME
	BOMARC	#		SAME	SAME	SAME	SAME
	HARK	#		SAME	SAME	SAME	SAME
	TARTAR	#		SAME	SAME	SAME	SAME
	SPARROW	#		SAME	SAME	SAME	SAME
	REDSTONE	#	D	SAME	SAME	SAME	SAME
TELECOMPUTING CORP 915 N. CITRUS AVE. LOS ANGELES 38, CAL. HO 4-3171	BULLPUP	WHITTAKER TYRO DIV. 16217 LINDBERGH ST. VAN NUYS, CAL. ST 3-1950		GYROS			
	BOMARC	SAME		SAME			
	NIKE-HERCULES	SAME		SAME			
	NIKE-AJAX	SAME		SAME			
		ENGINEERING SERV. DIV. 12838 SAICOY ST. NO. HOLLYWOOD, CAL. ST 7-6181		DATA PROCESSING			
	ATLAS	LOS ANGELES DIV.		BATTERIES			
	MINUTEMAN	SAME		SAME			
TELKOR, INC. BOX 186 ELYRIA, OHIO FA 2-8623		#	B	FREQUENCY CONVERTERS	H. ROE	H. ROE	H. ROE
TEMCO AIRCRAFT CORPORATION P.O. BOX 6191 DALLAS 22, TEXAS BR 6-7111	CORVUS	MISSILES & ACFT. DIV.		MISSILE SYSTEMS AND AIRFRAMES	T. COURTNEY	E. MILLER	C.D. COLLIER
	HARK	SAME		WINGS AND ELEVONS	SAME	SAME	SAME
	SERGEANT	SAME		SHIPPING AND STORAGE CASES	SAME	SAME	SAME
	TEAL	SAME		DEVELOPMENT	SAME	SAME	SAME
	ALPHA	SAME		DEVELOPMENT	SAME	SAME	SAME
	GAR-9	SAME		ELEVATORS	SAME	SAME	SAME
TETRAFLUOR, INC. 343 HINORY AVENUE INGLEWOOD 1, CALIF. OR 8-4056	ATLAS	#	C	TEFLON SPIRALS, BACK UP RINGS, SEALS	E. YOUNG	W. STAHL	J. RIEMER
			B				
	NIKE-ZEUS	#	C	SAME	SAME	SAME	SAME
	THOR	#	C	SAME	SAME	SAME	SAME
	BOMARC	#	C	SAME	SAME	SAME	SAME
	REGULUS	#	C	SAME	SAME	SAME	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000 B—$50,000—$100,000 C—$100,000—$500,000 D—$500,000—$1 million E—$1—$10 million F—$10—$25 million G—$25—$50 million H—$50—$75 million I—$75—$100 million J—$100—$250 million K—Over $250 million

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)		$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
TEXAS INSTRUMENTS INC. 6000 LEMMON AVE. DALLAS 9, TEXAS FL 7-5411	BOMARC	APPARATUS DIV.		E	TELEMETRY	J. SMITH	C. WHITLEDGE	F. WOODRICH
	CENTAUR	SAME		C	SAME	SAME	SAME	SAME
	CORVUS	SAME		E	TELEMETRY, GUIDANCE	SAME	SAME	SAME
	SAR-2	SAME		E	IR OPTICS	W. HARMAN	SAME	SAME
	SAR-4	SAME		E	SAME	SAME	SAME	SAME
	MERCURY	SAME		C	TRANSMITTER	J. SMITH	SAME	SAME
	MINUTEMAN	SAME		B	TELEMETRY	SAME	SAME	SAME
	NIKE-ZEUS	SAME			GROUND DISPLAYS	J. MORRISON	SAME	SAME
	PERSHING	SAME		E	TELEMETRY FLIGHT PROGRAMMER	J. SMITH	SAME	SAME
	RASCAL	SAME		F	GUIDANCE	G. HELMS	SAME	SAME
	REGULUS II	SAME		E	INERTIAL PLATFORM SUBSYS.	T. SMITH	SAME	SAME
	SARAH	SAME		B	GUIDANCE	G. HELMS	SAME	SAME
	SENTRY	SAME		C	MISSION PROGRAMMER	T. SMITH	SAME	SAME
	SIDEWINDER	SAME		C	OPTICS	W. HARRMANN	SAME	SAME
	SPARROW	SAME		A	SAME	SAME		
	THOR-ABLE	SAME		C	BEACON TRANSPONDER	G. HELMS	SAME	SAME
	THOR-DELTA	SAME		C	FLIGHT PROGRAMMER	T. SMITH		
	TITAN	SAME		E	LAUNCH PROGRAMMER	SAME		
	VEGA	SAME		C	TELEMETRY	SAME		
		M & C NUCLEAR INC. BOX 898 ATTLEBORO, MASS.		C	NUCLEAR FUEL COMPONENTS	R. DELAGI	T. SNYDER	A. STERLING
THIOKOL CHEMICAL CORP. BRISTOL, PENNA. WI 6-9150	NIKE ZEUS	"			BOOSTER MOTOR			
	MINUTEMAN	"			FIRST STAGE PROPELLER			
	SUBROC	"			SOLID PROPELLANT PROPULSION			
	SWALLOW	"			SAME			
	PERSHING	"			SAME			
	POLARIS	ELKTON DIV. ELKTON, MD.	1100		PROPULSION SYSTEM			
	SUBROC	"			SAME			
	FALCON	LONGHORN DIV. MARSHALL, TEXAS	AE 5-5211		SAME			
	LACROSSE	SAME			SAME			
	NIKE HERCULES	SAME			SAME			
	ATLAS	REACTION MOTORS DIV. DANVILLE, N.J.	DA 7-7000		FUELING			
	CORVUS	SAME			PROPULSION SYSTEM			
	TITAN	SAME			SAME			
	DERVISH	REDSTONE DIV. HUNTSVILLE, ALA.	JE 6-4411		SAME			
	GENIE	SAME			FUELING			
	HARK	SAME			PROPULSION SYSTEM			
	LITTLE JOE	SAME			SAME			
	MACE	SAME			SAME			
	MATADOR	SAME			SAME			
	MERCURY	SAME			SAME			
	PERSHING	SAME			SAME			
	SCOUT	SAME			SAME			
	SERGEANT	SAME			SAME			
	SPARROW	SAME			SAME			
	X-17	SAME			SAME			
THIOKOL CHEMICAL CORPORATION BRISTOL, PA. EX 8-3000	SUBROC	ELKTON DIV. ELKTON, MD.			DEVELOPMENT OF PROPULSION UNIT			
	MERCURY	SAME			RETROGRADE ROCKET ENGINES			
	SWALLOW	SAME			BOOSTER ROCKET ENGINES			
	FALCON	SAME			PROPULSION RESEARCH			
	FALCON	SAME			PROPULSION R & D SUPPORT FOR FALCON FAMILY OF WEAPONS			
THOMPSON RAMO WOOLDRIDGE INC.	PERSHING	TAPCO GROUP			TRANSPORTER-ERECTOR-LAUNCHER			
	TERRIER 1 & 11	SAME			LAUNCHER COMPONENTS			
	BOMARC	SAME			MISSILE SHELTER			
	HOUND DOG	SAME			PUMPS, AUX. POWER			
	ATLAS	THOMPSON PROD. CO. BOX 90067 ARPT. STA. LOS ANGELES 45, CAL.	OS 5-1601		SYSTEMS ENGINEERING			
	MINUTEMAN	SAME			SAME			
	THOR	SAME			SAME			
	TITAN	SAME			SAME			
	SENTRY	SAME			RADIATION STUDY EQUIPMENT			
	SERGEANT	SAME			DATA REDUCTION SYS.			
	TERRIER LAII	ROANOKE FACILITY ROANOKE, VA.			AUX. POWER			
	BOMARC				SAME			
	DONA-SOAR				SYSTEM & WARHEAD STUDIES			
	GREEN QUAIL				AUX. POWER UNITS			
	BULL GOOSE	THOMPSON PRODUCTS			GUIDANCE			
	DEFENDER				RESEARCH & DEVELOPMENT			
TINIUS OLSEN TESTING MACHINE CO. EASTON ROAD WILLOW GROVE, PENNA. OS 5-7100		"		C	PHYSICAL TESTING MACHS. CALIBRATING	G. LAWKIP	F. BIEKOWSKI	C. KEYSER
TOPPER MFG. CO., INC. JAMAICA 32, N.Y. AX 7-5742	ATLAS	"		A	PLASTIC FOAM INSULATOR	F. DAVIDSON		
	DISCOVERER	"		A	POTTED CIRCUITS	SAME	"	
				A	TEST SYSTEM	SAME		
				A	FOAM CASE FOR INERTIAL GUIDANCE	SAME		
C. A. TURNGREN CO., INC. SOMERVILLE 45, MASS. HO 6-3450		"			THRUST CHAMBERS, BELLMOUTHS, REFLECTORS	J. VERGARI	H. FONZO	W. URCAIN
TOROTEL, INC. 5512 EAST 10TH ST. KANSAS CITY 37, MO. SO 1-6314				D	MOLDED COILS MAGNETIC AMPLIFIERS, FILTERS	H. RHODES	F. CAMPBELL	D. SIZEMORE
C. TORRES ENGINEERING CO., INC. 5 CAROLINE STREET S. HACKENSACK, N.J. HU 7-4760	ATLAS	"		A	SWITCHES	C. TORRES	E. POWELL	G. BURNS

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	S*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
TRACERLAB INC. 1601 TRAPELO ROAD WALTHAM, MASS. TW 4-6600	"	"	B	X-RAY COMMUNICATIONS	J. BRINKERHOF		
	"	"	A	PLANETARY ATMOSPHERE STUDY	C. ZEIGLER		
	"	"	A	RADIOCHEMICAL ANALYZER	D. CHLECK		
TRAD ELECTRONICS CORPORATION 1001 FIRST AVENUE ASBURY PARK, NEW JERSEY	TALOS	"		POWER SUPPLIES	H. WEST	B. MOSER	M. WALKER
THE TRANE CO. 206 CAMERON AVENUE LA-28000 LA CROSSE, WIS.	MACE	"	A	HEAT EXCHANGERS	J. CUSTER		J. CUSTER
TRANSFORMER DESIGN, INC. 7777 N. 76TH STREET MILWAUKEE 23, WIS. FL 3-8017	TITAN	"		TRANSFORMERS REACTORS	JNO. KNOPOW	R. LESGOLD	R. LESGOLD
	THOR	"		SAME	SAME	SAME	SAME
	MACE	"	C	SAME	SAME	SAME	SAME
TRANS-SIL CORPORATION 54 HONECK STREET ENGLEWOOD, N.J. LO 7-1720	MARK	"	A	RECTIFIERS	R. DORR	O. LYONS	I. WEINSTEIN
TRANTER MFG., INC. 735 E. HAZEL STREET LANSING, MICHIGAN IV 4-4531	POLARIS	"	D	HEAT EXCHANGERS	C. SMITH	R. SMOCK	R. SAXTON
TRUE-TRACE CORPORATION 9831 E. RUSH STREET EL MONTE, CALIF. CU 3-4761	ATLAS	"		FUEL VALVES	R. ROSEBROOK	E. OWENS	
	THOR	"		SAME	SAME	SAME	
	JUPITER	"		SAME	SAME	SAME	
TRW COACH COMPANY 30 S. CAYUGA ROAD BUFFALO N.Y. PL 51510	MARK	AIRCRAFT DIV. CAYUGA ROAD BUFFALO, N.Y. PL 5150	C	ELECTRONIC CONSOLES			
	HOMARC	SAME	A	HOND ASSEMBLY			

U

UNION CARBIDE CORP. 30 EAST 42ND STREET NEW YORK, N.Y.	TERRIER	LINDE CO. 90 E. 42ND ST. NEW YORK, N.Y. MU 7-8000		SPOT-WELDING MACHINE LIQUID HYDROGEN			
UNITED AIRCRAFT CORPORATION 400 MAIN STREET EAST HARTFORD, CONN. JA 8-4811	POLARIS	NORDEN LABORATORIES DIV. 121 WESTMORELAND AVE. WHITE PLAINS, N.Y. WH 6-4300		STABILIZATION MEASURING INSTR			
	ATLAS	SAME		DIGITAL TECHNIQUES, SIMULATION			
	TITAN	SAME		GUIDANCE & CONTROL			
	MANNED SATELLITE	PRATT & WHITNEY AIRCRAFT 400 MAIN STREET		SECOND STAGE ENGINE			
	SNARK	SAME		POWERPLANT			
	XS-1310	SAME		SAME			
	HOUND DOG	SAME		SAME			
UNITED AIRCRAFT PRODUCTS, INC. 116 ROLANDER AVENUE DAYTON 10, OHIO RA 4-3841		"	E	HEAT EXCHANGERS, CONTROLS	K. PARKER	G. CAMPBELL	D. UNANGST
UNITED CONTROL CORPORATION 6500 UNION BAY PLACE SEATTLE 5, WASHINGTON LA 5-9600	HOMARC	"	C	MAGNETIC AMPLIFIER	J. COZINE	K. SMITH	H. LAVILLE
		"					
	HOMARC	"	C	POWER CHANGEOVER SWITCH	G. STAGARD		
	ATLAS	"	D	SAME	P. ROUTLEDGE		
	ATLAS	"	A	POWER CHANGEOVER SWITCH	P. ROUTLEDGE		
	THOR	"	C	PROPELLANT LOADING COMPUTER	G. MITCHELL		
	THOR	"	B	LOX & FUEL LEVEL SWITCHES	E. GALYEAT		
	POLARIS	"	A	TEMPERATURE CONTROL SYSTEM	R. KNIGHT	K. SMITH	H. LAVILLE
	TITAN	"	B	TRANSFORMER-RECTIFIER	J. JOHNSON		
	MERCURY	"	A	SWITCHES	R. KNIGHT		
	HOUND DOG	"	A	SAME	SAME		
	HOUND DOG	"	A	SAME	E. GALYEAT		
	SIDEWINDER	"	C	LAUNCH ZONE SYSTEM	G. MITCHELL		
	SATURN	"	A	LIQUID LEVEL SWITCH	R. ALLYN		
UNITED ELECTRIC CONTROLS COMPANY 85 SCHOOL STREET WATERTOWN, MASS. WA 6-1000	LACROSSE	"	A	PRESSURE CONTROLS	D. WILLIAMS	J. GRIFFIN	G. CLAPP
		"					
		"					
	ATLAS	"	A	TEMPERATURE CONTROLS	R. CHAMBERLIN	SAME	SAME
	THOR	"	A	TEMPERATURE CONTROLS	SAME	SAME	SAME
UNITED ELECTRODYNAMICS, INC. *PASADENA, CALIF. SY 9-7161	TITAN	"	D	TELEM. SYS. CABLE STUB	R. MAXSON	E. ROTHENBERGER	E. LEMKE
				TELEMETRY			
	DISCOVERER	"	D	GROUP	P. KLASKY	R. HACKSTOCK	SAME
	SERGEANT	"	D	TELEM. SYST. & COMP.	J. STIMSON	E. SANDBLOOM	SAME
	THOR	"	D	TELEM SY. GRD. CONT. EQUIP.	R. MAXSON	E. ROTHENBERGER	SAME
	MINUTEMAN	"	D	TELEM. SYST.	N. LAPASTNSKI	R. HACKSTOCK	SAME
	ATLAS	"	C	TELEM. SY. GUIDANCE GROUP	R. MAXSON	E. ROTHENBERGER	SAME
	HOUND DOG	"	C	TELEM. SYST.	N. LAPASTNSKI	E. SANDBLOOM	SAME
	AP-76	"	C	GROUND EQUIP.	G. HATCHETT	M. HALL	SAME
	JAVELIN/JOURNEYMAN	"	C	TELEM. SYS. COMP.	W. SMITH	R. HACKSTOCK	SAME

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million	

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	S*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
UNITED ELECTRODYNAMICS, INC. [illegible]	TERRIER	"	C	FUZE TELEMETRY	A. DESMORE	H. MACKSTOCK	SAME
	SD-5 DRONE	"		DRONE TEL. SYS.	N. LAPASTNSKI	E. ROTHENBERGER	SAME
				RECOVERY TEL. SYS.			
	SD-4 DRONE	"	B	TELEM. SYST.	SAME	SAME	SAME
	VEGA	"	B	VARIOUS AIRBORNE COMPONENTS	J. STIMSON	R. MACKSTOCK	SAME
	PIONEER	"	A	TELEMETRY COMPONENTS	J. STIMSON	E. ROTHENBERGER	E. LEMKE
	NIKE-ZEUS	"	S	GROUND EQUIPMENT	C. MILLER	SAME	SAME
U. S. FLEXIBLE TUBING CO. BARTLETT, ILL. TE 7-2581		"	B	BELLOWS AND DUCTS	R. GORDON	R. GORDON	R. ANDERSON
U.S. GEAR CORPORATION 81 BAY STATE ROAD BAKERFIELD, MASS. CR 6-4900		"	A	PRECISION GEAR UNITS	P. COTREAU	H. HERSEY	A. CAMARA
		"	"				
U.S. INDUSTRIES, INC. 250 PARK AVENUE NEW YORK, N.Y.		CLEARING DIV. 6499 S. 65TH ST. CHICAGO 38, ILL. PO 7-8700	D	TOOLING & MACHINING	K. DRONE	J. MICHELOTTI	J. HIGART
U. S. NAVAL PROPELLANT PLANT INDIAN HEAD, MD. RI 3-2111	TERRIER	CAST PROPELLANT DIV.		GRAIN MANUF. MOTOR LOADING	J. CLANCY	F. BERNARD	J. KENLON
	TALOS	SAME		SAME	SAME	SAME	SAME
	SNARK	SAME		SAME	SAME	SAME	SAME
	BULLPUP	SAME		SAME	SAME	SAME	SAME
	WEAPON A	SAME		SAME	SAME	SAME	SAME
	BOAR	SAME		SAME	SAME	SAME	SAME
	SIDEWINDER	EXTRUDED PROP. DIV.		GRAIN MANUF.	I. TOMLINSON	R. SPEAKE	SAME
	ASROC	SAME		GRAIN MANUF. MOTOR LOADING	SAME	SAME	SAME
	ZUNI	SAME		GRAIN MFG.	SAME	SAME	SAME
UNITED STATES STEEL CORP. 525 WILLIAM PENN PLACE PITTSBURGH 30, PENNA. EX 1-2345	ATLAS	NATIONAL TUBE DIV. 2214 WALNUT STREET MCKEESPORT, PA. OR 8-8841		HIGH PRESSURE CYLINDERS	K. BRYNAN	F. TERRELL	J. DAILEY
	TITAN	SAME		SAME	SAME	SAME	SAME
	POLARIS	SAME	E	SAME	SAME	SAME	SAME
UNIVERSAL DYNAMICS CORPORATION BOX 9814 ARLINGTON, VIRGINIA JA 5-4541	ATLAS	"	G	AIR CONDITIONING & DEHUMIDIFIER.	D. WATSON	C. SWINNELL	K. BURNS
UNIVERSAL MFG. CO., INC. 1168 GROVE STREET IRVINGTON 11, NEW JERSEY ES 4-9800	NIKE ZEUS	"	B	DIES, FIXTURES, MACHINED COMPONENTS, ASSBLY	W. A. BERNAV	R. F. SCHNELL	W. E. AHENDS
	FALCON	"	A	SAME	SAME	SAME	SAME
	TAL.SNAR.TERR.PE	"	S	SAME	SAME	SAME	
	HUSTLER	"	S	SAME	SAME	SAME	SAME
					SAME		
UNIVERSAL TOROID COIL WINDING 171 COIT STREET IRVINGTON 11, N.J. ES 4-9806	NIKE ZEUS	"	A	TOROIDAL COMPONENTS	A. G. VICARI	E. RACHNER	W. E. AHENDS
ULTRA ELECTROFORMING & MFG. CO. 110 CEDAR AVENUE PITMAN, N.J.		"	B	ELECTROFORMED PARTS	E. CARTER	W. STAFFORD	E. CARTER
ULTRASONIC TESTING & RES. LAB. 14712 RAYMER STREET VAN NUYS, CALIF. ST 0-5856		"	A	SOLID FUEL TESTING	R. MCKOAN	G. CROSS	R. KLEINT
ULTRONIX, INC. 111 EAST 20TH AVENUE SAN MATEO, CALIF. FI 5-7921			E	ULTRASONIC TEST STANDARDS RESEARCH	R. MCKOAN	G. CROSS	R. KLEINT

V

VALCOR ENGINEERING CORPORATION 345 CARNEGIE AVE. KENILWORTH, N.J. CH 5-1665		"	A	SOLENOID VALVES FOR REDSTONE, NIKE, JUPITER, SIDEWINDER	G. KELLY	M. SILVERMAN	T. PIAS
VAN NORMAN INDUSTRIES, INC. 186 GRANITE ST. MANCHESTER, N.H. NA 5-9701	MINUTEMAN	ELECTRONICS DIV. 186 GRANITE ST. MANCHESTER, N.H.	G	TEST EQUIPMENT	S. CUKER	R. SALZER	S. CAPERELL
VAPOR HEATING CORPORATION 80 EAST JACKSON BLVD. CHICAGO 4, ILLINOIS WA 2-5160	ATLAS	VAP-AIR DIV. 6448 S. HOWARD ST. CHICAGO 48, ILL. MI 7-8300		TEMPERATURE CONTROLS	W. G. PARKS	H. SELHORST	R. G. CURRER
	JUPITER	SAME	C	SAME	SAME	SAME	SAME
	PERSHING	SAME	C	SAME	SAME	SAME	SAME
	POLARIS	SAME	C	SAME	SAME	SAME	SAME
	REDSTONE	SAME	C	SAME	SAME	SAME	SAME
	THOR	SAME	C	TEMPERATURE ALARM SYSTEM	SAME	SAME	SAME
	TITAN	SAME	C	TEMPERATURE CONTROL	SAME	SAME	SAME
VECTOR ENGINEERING CONTRACTORS 3210 ELM ST. DALLAS 26, TEXAS RI 7-9343			E	VACUUM TEST EQUIPMENT	W. BOELSTAN	J. HOLLEY	E. EIFENBEIN
VERTOL AIRCRAFT CORPORATION MORTON, PENNA. KI 3-4000	HAWK	"	E	COMPONENTS	H. TOREY	J. MURPHY	W. BOCKUS
		"					
VIDEO INSTRUMENTS COMPANY, INC. 3002 PENNSYLVANIA AVENUE SANTA MONICA, CALIFORNIA EX 3-1284		"	D	POWER SUPPLIES, BALANCES	G. YOUNG	R. COBERY	R. UPOMMER
		"	C	DC AMPLIFIERS	SAME	SAME	SAME
VIRGINIA ELECTRONICS COMPANY, INC. 5205 RIVER ROAD WASHINGTON 16, D.C. OL 4-6680	AEROBEE	"	A	ELECTRONIC ASSEMBLY	L. ATHANAS	D. SAUNDERS	E. SCHWARTZ
			B	CIRCUIT PROGRAMMING	A. COHEN	A. MURAD	E. SCHWARTZ

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	$*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
VITRO CORP. OF AMERICA 261 MADISON AVE. NEW YORK 16, N.Y. MU 2-5700		VITRO ENGINEERING 7 E. 12TH STREET NEW YORK, N.Y.	E	OPERATIONAL SER. FOR BOMARC & SAGE	H. BRENNER		M. HORNYAK
	POLARIS	VITRO LABS 14000 GEORGIA AVE. SILVER SPRING, MD. WH 2-7200	E	SYSTEMS ENGINEERING	H. WILLIAMSON		E. FOWLER
	TERRIER	SAME	S	SAME	W. GREEN	SAME	SAME
	TALOS	SAME	S	SAME	SAME	SAME	SAME
	EAGLE	SAME	C	SHIPBOARD LOGISTICS	A. ERICKSON		R. MARTIN
	TARTAR	SAME	E	SAME	SAME		E. FOWLER
	TERRIER (LB)	SAME	C	SAME	M. CLINE		SAME
		VITRO & ORANGE LAB. PLEASANT VALLEY WAY WEST ORANGE, N.J.	C	PLASMA PROPULSION	C. FITZ		EATON
VOUGHT COMPANY P.O. BOX 13500 BEVERLY HILLS, CALIF. CR 6-1131				PHOTO DATA RECORDING EQUIPMENT	A. FRASER	A. FRASER	W. LANCTOT
VULCAN ELECTRIC COMPANY 68 HOLTON STREET DANVERS, MASS. SP 4-1730	SPARROW			ELECTRIC HEATERS	N. HILL	J. HARRIS	J. HARRIS
			W				
WALDALE RESEARCH COMPANY, INC. 362 WEST COLORADO BLVD. PASADENA, CALIF. NU 1-4946	NIKE	#	A	DEFLECTION GAGES FOR STAGE SEPARATION	G. ARDENMEYER	A. SCHOMMERG	F. SINGDALE
	POLARIS	#	A	DEFLECTION GAGES FORCE GAGES	SAME	SAME	SAME
	ATLAS	#	A	SAME	SAME	SAME	SAME
WALTHAM ELECTRONICS CORP. 751 MAIN ST. WALTHAM 54, MASS. TW 4-7910		#	A	SIGNAL GEN.	A. KALISKY	E. MAXWELL	I. KADESH
WASHINGTON MACHINE & TOOL WORKS 13111 WAYZATA BLVD. MINNEAPOLIS 26, MINN. LI 5-5611	LACROSSE	#	D	RADIO COMMAND SYSTEM COMP	B. DICKENSON	S. GORMAN	R. SMITH
		#	D	SERVO-MECHANISMS, MODELES	J. GRASLEWICZ	S. GORMAN	B. SMITH
WASHINGTON STEEL CORPORATION WASHINGTON, PA. BA 2-8000	ATLAS	#		STAINLESS STEEL SKIN	A. STARGARDTER	E. FRANK	T. FLAHERTY
WASTE KING CORP. 4600 S. PACIFIC BLVD. LOS ANGELES 58, CAL. LU 3-4721	JUPITER	#		HEAT EXCHANGERS, VALVES, PUMPS, CHAMBERS, CONTROLS			
	PERSHING	#		GYRO STABILIZER SYSTEM			
	ATLAS	#		HEAT EXCHANGERS			
	THOR	#		SAME			
WATERMAN HYDRAULICS CORP. EVANSTON, ILL. GR 5-7045		#	B	PROPELLANT FLOW CONTROL UNITS	E. DYAL	P. WATERMAN	R. RHONEY
		#	C	HYDRAULIC FLOW CONTROL VALVES	H. HEDLAND	SAME	SAME
			B	FLUID METERING DEVICES	H. HEDLAND	SAME	SAME
			C	HYDRAULIC FUSES AND VALVES	H. HEDLAND	SAME	SAME
			B	SELECTOR VALVES	W. THOMAS	SAME	SAME
THE WEATHERHEAD COMPANY 300 E. 131ST STREET CLEVELAND 8, OHIO GL 1-5400	BOMARC	WESTERN DIV. 1736 STANDARD AVE. GLENDALE, CALIF. CH 5-6975	B	GROUND SUPPORT	F. ALLEN	G. SMIER	G. SMIER
	HOUND DOG	EASTERN AIRCRAFT DIV. 300 E. 131ST STREET CLEVELAND, OHIO GL 1-5200	C	COMPONENTS			
	BULL PUP						
	ATLAS	SPECIAL PRODUCTS DIV. 300 E. 131ST ST. CLEVELAND, OHIO GL 1-5200	C	COMPONENTS			
	TITAN	SAME	B	COMPONENTS			
	JUPITER	SAME	A	COMPONENTS			
	REDSTONE	SAME	A	COMPONENTS			
	THOR	SAME	A	COMPONENTS			
	POLARIS	SAME	B	COMPONENTS			
	SPARROW III	SAME	C	COMPONENTS			
WESTERN DEVELOPMENT & MFG. CO. 345 BOSTON POST ROAD MILFORD, CONN. TR 4-6735	HOUND DOG	#		FUEL PRESSURE SWITCH	J. YOWELL	C. SCHWAB	R. OAKE
WESTERN ELECTRIC CO., INC. 120 BROADWAY NEW YORK 5, N.Y. WO 4-2100	NIKE HERCULES	208 GRAHAM-HOPEDALE BURLINGTON, N.C.	K	GUIDANCE EQUIP.	E. BESCHERER	F. HENDERSON	C. ZARTMAN
	TERRIER		F		SAME	SAME	SAME
	NIKE ZEUS	BELL TELEPHONE LABS WHIPPANY ROAD WHIPPANY, N.J.	K	R & D	L. MORRISON		
	TITAN	SAME	J	GUIDANCE EQUIPMENT	E. FELCH		
	DELTA	SAME	C	SAME	SAME		
	THOR ABLE	SAME	C	SAME	SAME		
	TERRIER	CHATAM ROAD WINSTON-SALEM, N.C.	F	WEAPONS DIRECTION EQUIP.	E. BESCHERER	F. HENDERSON	C. ZARTMAN
	TARTAR	SAME	S	SAME	SAME	SAME	SAME
	TITAN	SAME		GUIDANCE EQUIPMENT	SAME	SAME	SAME
	DELTA	SAME	C	SAME	SAME	SAME	SAME
	THOR ABLE	SAME	D	SAME	SAME	SAME	SAME
WESTERN INSULATED WIRE CO. LOS ANGELES, CALIF.		#	E	POWER CABLE GROUND SUPPORT & LAUNCHING EQUIP.	I. HILL	E. ESTRIN	P. HANDS

*Code for Approximate Contract Dollar Value

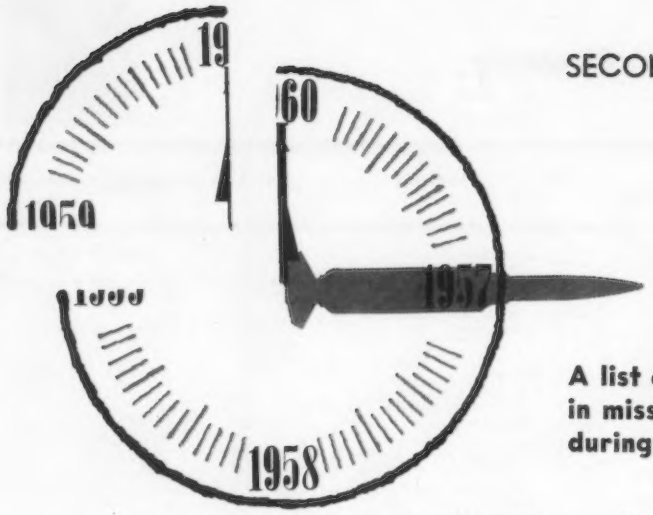
A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	K—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		

Contractors' Directory

CONTRACTOR	PROJECT	PLANT (See contractor's address)	S*	PRODUCTS	ENGINEERING	PRODUCTION	PROCUREMENT
WESTERN MOLDED FIBRE PRODUCTS, INC 18103 S. BRIGHTON AVENUE GARDENA, CALIF. FA 1-3674	ZUNI	"	C	NOSE & TAIL CONES ROCKET LAUNCHER	P. DELUCA	D. SECARD	W. MCLAUGHLIN
WESTGATE LABORATORY, INC. 506 S. HIGH ST. YELLOW SPRINGS, OHIO RO 7-7375	DRONE	"	A	AMPLIFIERS	R. SCHROEER	E. UNDERHILL	J. KING
WHEELOCK SIGNALS INC. LONG BRANCH, N.J. CA 2-6880	NIKE HERCULES	"	D	RELAYS	J. RUSSO	P. DUSINBERRE	J. GOULD
WINANCKO ENGINEERING COMPANY PASADENA, CALIF. MU 1-4471	BOMARC	"	C	TRANSDUCER'S	R. NAKASONE	R. SPURLOCK	J. CHAFFIN
	X-A	SAME	D	TRANSDUCERS	R. SHAW	SAME	SAME
	SATURN	SAME	C	TRANSDUCERS AND AM SYSTEMS	W. TIMM	SAME	SAME
	MERCURY	SAME	A	TRANSDUCERS AND FM SYSTEMS	K. WINSOR	SAME	SAME
E.B. WIGGINS OIL TOOL CO., INC. 3424 E. OLYMPIC BLVD. LOS ANGELES 23, CALIF. AN9-0181		"	E	COUPLINGS FOR POLARIS, TATAN, HOUND DOG, BOMARC, HAWK, PERSHING, GREEN QUAIL	S. GOTTLIEB		T. SMART
WINDER AIRCRAFT CORP. DUNNELLON AIR BASE, P.O. DRAWER #8 DUNNELLON, FLA. HU9-2411	ALPHA	"		RESEARCH & DEVELOPMENT	D. DUTTON	O.E. HENDERSON	M. WILCHAK
	VALKYRIE	"		R & D GROUND SUPPORT WEAPON	J. FREIDEL	J. THOMAS	N. HARRIS
	TERRIER	WINDER AIRCRAFT CORP. P.O. BOX 2397 LAKELAND, FLA. HU9-6911		GROUND SUPPORT	E. WHITE	A. MC CAGHREN	A. HARRIS
WISE AERODRAULICS, INC. 13431 TRISKETT RD. CLEVELAND 11, OHIO OR1-4730	NIKE	"	B	ORDINANCE DEVICE			L.C. WISE
WORTHINGTON CORPORATION	ATLAS	NORWOOD, MASS.	C	CONTROL VALVE & INSTRUMENTS			
HARRISON, N.J. HU4-1234		NO7-4600					
	TITAN	SAME	E	SAME			
	BOMARC	SAME	B	SAME			
WYMAN-GORDON CO. 105 MADISON ST. WORCESTER 1, MASS. PL6-5111	ATLAS	"		FORGINGS			
	BOMARC	"		SAME			
	BULLPUP	"		SAME			
	HAWK	"		SAME			
	HOUND DOG	"		SAME			
	LA CROSSE	"		SAME			
	MACE	"		SAME			
	MINUTEMAN	"		ROCKET CASES			
	NIKE HERCULES	"		FORGING			
	POLARIS	"		SAME			
	SERGEANT	"		SAME			
	TARTAR	"		SAME			
	TITAN	"		SAME			
	PERSHING			SAME			
				X			
				Y			
YARDNEY ELECTRIC CORP. 40-50 LEONARD ST. NEW YORK 13, N.Y. WO6-3100		"		BATTERIES FOR ATLAS, BOMARC, TITAN, POLARIS, AEROJET, REDSTONE MINUTEMAN, JUPITER, SNARK, THOR	B. BLAKE	J. ZARDVICH	L. KATZ
				Z			
ZEP AERO 113 SHELDON ST. EL SEGUNDO, CALIF. OR8-1161		"	C	COMPONENT TEST	A. WILSON	V. GARNER	F. GIFFORD
		2120 S. PLATTE RIVER DRIVE DENVER 23, COLO. PE3-0677	A	SAME	A. TAMILLOW	O. MAILLE	J. TAMILLOW

*Code for Approximate Contract Dollar Value

A—$10,000—$ 50,000	C—$100,000—$500,000	E—$1 —$10 million	G—$25—$50 million	I—$75 —$100 million	L—Over $250 million	
B—$50,000—$100,000	D—$500,000—$1 million	F—$10—$25 million	H—$50—$75 million	J—$100—$250 million		



SECOND ANNUAL

Space Age Chronicle

A list of significant events in missilry and astronautics during the calendar year 1959

A new era began on Oct. 4, 1957, with the launching of Sputnik into Earth orbit by the USSR. The significant events which followed, up to Jan., 1959, were listed in The First Annual Aircraft and Missiles Space Age Chronicle. This second annual chronicle is based on editorial staff research, and covers events from Jan. 1, 1959, to Jan. 1, 1960.

1959

January 2: U.S.S.R. launches Lunik, first moon rocket later dubbed Mechta.

January 4: Mechta reported passing 4660 mi from the Moon. Instrument package weighing 769.5 lb hurtles towards 15 month eliptical orbits around the Sun; top speed will reach estimated 72,000 mph.

January 12: McDonnell Aircraft wins prime contract to design and produce capsules. Project Mercury—U. S. effort to orbit a man around Earth.

January 16: Public unveiling of SNAP III, 5-lb atomic generator powered by radioactive isotopes.

January 21: Army launches first tactical Jupiter over 1700 mi distance; announces it hit target.

January 23: Thor-Able launched, fails to travel 4400-mi test distance.

January 27: Successful 4000-mi test of Atlas.

January 28: NASA announces it has picked 110 candidates for Project Mercury tests.

January 29: NASA announces that the March 17 Vanguard satellite showed Earth is pear-shaped.

February 2: NASA's 10-year space program outlined to Congress.

February 3: Titan fails to leave launching pad in second attempt at Canaveral. Automatic sequencer shut down first-stage propulsion after two sec. burning time; missile undamaged.

February 4: Thirteenth successful Atlas flight, 4300 nautical miles.

February 6: First successful Titan firing (first stage).

February 16: Air Force test fires new solid-fueled rocket, reportedly about 40 ft long and much slimmer than Polaris. Now believed to be Pershing.

February 17: Vanguard II world's first meteorological satellite, orbited. Sends rough optical data on Earth's cloud cover.

February 20: Atlas explodes shortly after firing.

February 25: 300 mile test flight checks out first stage of Titan. Second successful Titan flight.

February 28: Discoverer I attempts polar orbit. Success questioned because of spotty radio signals.

March 3: Pioneer IV, first U. S. Moon rocket, launched; transmits data on radiation belts; passes within 37,300 mi of Moon, goes toward 394-day orbit around the Sun.

March 10: Snark makes successful round-trip ocean flight from Canaveral, distance intercontinental. . . . NASA announces Scout rockets, low cost means of launching satellites or high altitude shots. . . . X-15 goes aloft first time under wing of B-52.

March 14: U. S. offers use of launch vehicles to other nations wishing to put test instrumentation in space.

March 19: Team from MIT's Lincoln Lab reveals sending and receiving signals from Venus. . . . **Project** Argus tests revealed. Three small nuclear bombs, exploded high over the South Atlantic in late Summer, 1958, caused electrons to be trapped in Earth's magnetic field. Experiment aided high altitude defense and helped map the magnetic field.

March 31: Navy announced plan for relaying radio signals between Washington and Pearl Harbor via Moon.

April 3: Third successful Titan test-firing, carries JATO bottles to push second stage ahead on separation. . . . Martin's Bold Orion rocket launched from B-47. . . . Jupiter fired 1500 miles.

April 6: Seven test pilots chosen for Project Mercury.

April 8: Air Force reveals it has recovered ceramic nose cone after 5000-mi shot. . . . Defense Department authorizes construction of three more Polaris subs.

April 9: Rocket engine of over one million lb thrust has been test fired by Rocketdyne.

April 13: Vanguard fails in attempt to launch two satellites at once. . . . 1600 lb Discoverer II orbited in first attempt to recover a space vehicle.

April 14: Atlas-D destroyed 15 sec after firing. Hold-down arm failed to release properly.

April 15: Capsule from Discoverer II believed to have fallen in Arctic region.

April 20: U. S.-Canada cooperative, space program announced. . . . Successful Polaris flight.

May 1: U. S. cancels Venus probes and 30,000 lb satellite shot.

May 5: Titan first-stage separation successful in test flight. Second stage not fired.

May 6: Convair receives $33.5 million NASA contract for eight Vega space vehicles. . . . House Space Committee authorizes $485,250,000 to NASA for FY 1960.

May 10: House Space Committee cites hope of world-wide communications satellite system by 1963.

May 13: Army receives first of eight Rocketdyne engines for Saturn development.

May 14: Intercontinental message beamed from Jodrel Bank to Air Force Cambridge Research Center via Moon.

May 18: Atlas explodes with operational type nose cone. . . . Polaris firing fails.

May 20: House approves $480,500,000 for NASA in FY 1960; includes $70-million for R&D.

May 21: Thor-Able nose cone travels 6000 miles from Canaveral and is recovered. . . . NASA reveals plans for 47 space launchings in the next 2½ years, including 11 lunar and interplanetary probes.

May 27: New Super Bomarc makes short-range maiden test-flight. Range called twice that of early Bomarcs.

May 28: NASA reveals it has recovered monkeys Able and Baker after 1965-mile trajectory in a Jupiter nose cone. Re-entry from 300 mile altitude was at 10,000 mph, 38 g's. . . . Army work on new "flying saucer" airplane disclosed by House Space Committee.

May 31: Project Echo plans announced.

June 1: ARPA announces Lockheed is prime for Project Midas. Discoverer, Sentry, and Midas are slated to receive $213,400,000 through fiscal year —over half ARPA's budget.

June 2: Senate Space Committee approves $485.3-million for NASA in FY 1960.

June 3: Discoverer III launched in first attempt to collect biological data in orbital flight. Second stage fired, but stage and 440-lb payload failed to orbit. 195-lb re-entry capsule contained four mice.

June 6: Army reveals egg fertilization experiment in Able-Baker Rocket, says it shows cell life can continue in space. . . . Pres. Eisenhower sends message from Boston to Prince Albert, Canada, via Moon. . . . Plans for joint U. S.-Canadian satellite in 1961 revealed. . . . Atlas explodes two min after launching.

June 7: Navy and NSF announce plans for cosmic ray study by plastic balloons.

June 8: X-15's first freeflight test. In the air 5 min 10 sec. . . . First missile mail by sub-launched Regulus to Jacksonville, Fla.

June 11: 5000-mile Thor-Able flight; nose cone is not recovered.

June 12: Additional $157-million earmarked for Nike-Zeus. . . . Navy discloses work on Astor long-range guided torpedo.

June 15: Plans for telescope-bearing, orbiting astronautical observatories revealed.

June 19: Bold Orion test-fired.

June 22: Vanguard (SLV-6) fired. Fails to orbit because of faulty 2nd stage pressure valve, which caused helium tank to burst at 50-mi altitude.

June 24: Administration rejects proposal for early construction of atomic airplane.

June 25: Discoverer IV fired, fails. "Insufficient velocity" cited.

June 28: Redstone chosen for one phase of Mercury training flights.

July 1: Plans revealed for atomic clock satellites. NASA contracts for developing different systems held by Hughes Aircraft and National Bureau of Standards.

July 5: Full-scale Polaris fired in 11th test. Second stage destroyed by ground control after flight control system apparently failed.

July 6: U.S.S.R. announced that two dogs and a rabbit were launched into space and recovered alive.

July 9: DOD says modified Titan first stage will be used as middle stage of a three-stage Saturn vehicle.

July 13: Plastic balloon goes to 139,500 ft in Project Skyhook. . . . Sunflare II launched; first of 12 high altitude firings to study solar flares.

July 16: Juno II vehicle carrying Explorer VI radiation-measuring satellite is destroyed by range safety officer 5 sec after launch. Power supply to guidance system failed.

July 18: First launching of Navy's Corvus air-to-surface missile.

July 24: Thor is shot 300 mi high. Camera in nose cone photographs earth and sun curvature. Later announced as first stabilized non-tumbling flight.

July 31: NASA announces it plans to soft-land a lunar seismograph.

August 3: Senate votes $530-million for NASA.

August 7: Explorer VI paddlewheel satellite orbited by Thor-Able III vehicle; measures radiation, sends "TV" pictures. . . . Project Tepee revealed "backscatter" techniques of bouncing radar off ionosphere may aid in detecting missile launchings.

August 10: Air Force says it will abandon plans to produce high-energy boron aircraft fuels at Olin Mathieson and Callery chemical. . . . Air Force announces it is cancelling contract with General Electric to produce the J-93-5 engine for the B-70.

August 13: Discoverer V shot from Pacific Missile Range into polar orbit. Capsule recovery fails. Thor-Agena stages used.

August 14: Modified June II fires inflatable Mylar payload. Fails to orbit because of premature fuel depletion in booster and attitude control malfunction. Would have measured atmospheric drag.

August 17: Nike-Asp shot 150 mi high.

August 19: Discoverer VI orbited by Thor-Agena. Data capsule not recovered.

August 21: Mercury escape mechanism fires prematurely in first test.

August 24: Atlas-C fired 5000 mi, takes pictures of earth from 700 mi up.

August 25: Malfunction in second stage separation during Polaris test.

continued on next page

August 27: Polaris test fired from Observation Island, surface ship.

August 28: Notus program for series of communications satellites announced.

August 29: Record, manned 31-G centrifuge run at Naval Air Development Center.

September 1: Air Force reveals successful test firing of XLR-99-RM-1 rocket engine for X-15.

September 9: Big Joe capsule fired 1500 mi recovered.

September 12: Lunik II, 858.4 lb sealed sphere launched. Multi-stage launching vehicle. Sphere composed of pentagonal strips of stainless steel made of two hermetically sealed shells of aluminum-magnesium alloy.

September 13: Lunik II's payload hits surface of Moon at 5:02:24 p.m. EDT. Total flight time about 25 hr; total distance 236,375 mi.

September 15: Air Force launches full-sized mock-up of Minuteman from Edwards AFB.

September 16: Atlas launched.

September 17: X-15's first powered flight, successful. . . . Transit I, 265-lb navigation satellite, fired by Thor-Able, but third stage fails to orbit payload.

September 18: Vanguard III (SLV-7) orbited. Spherical payload with tapered tube to measure earth's magnetic field, solar X-rays. Shell is polished silicon-monoxide-coated magnesium.

September 20: Defense Dept. reveals Air Force has ordered nuclear ramjet engine.

September 21: Air Force says it will study stars from stabilized platforms 10 mi above Earth.

September 22: Missile-firing sub, the Patrick Henry, is launched.

September 23: Air Force is assigned chief responsibility for developing, producing, and launching most space boosters. . . . Air Force cancels F-108 development program. New air-launched missiles believed one factor in cancellation.

September 24: Atlas-Able explodes during static-firing preceding Moon shot attempt.

September 28: NASA says Explorer VI has shown new radiation belt under inner Van Allen belt.

September 29: Project Sunflare data shows solar temperatures may run as high as 190 million °F.

September 30: Arcas shoots 3-ft plastic balloon 35,000 ft high.

October 4: Lunik III, Russian Translunar Earth Satellite, launched, escapes Earth. Contains cameras with developing and transmitting mechanism. . . . Little Joe fired in successful test of Mercury launching and destruct system.

October 6: Lunik III reaches closest point to Moon—4,373 mi. . . . Air Force fires Atlas 5500 miles, Thor 1700 miles.

October 7: Lunik III cameras triggered about 40,000 mi from Moon's surface, produced high precision photographs showing 70 per cent on Moon's "dark side."

October 10: Lunik III reaches apogee —292,000 miles from Earth—in 625,-000-mi, 15-day highly eccentric orbit.

October 12: Polaris fails. Second-stage malfunction.

October 13: Explorer VII, 91.5-lb NASA-Army satellite composed of two truncated cones joined at base, is orbited by modified Juno II. Shell is fiberglass and sand-blasted aluminum foil. Measures radiation balance, Lyman-Alpha X-ray, primary cosmic rays. . . . Two-stage Bold Orion missile fired from B-47 to proximity of orbiting Explorer VI. Missile was last of ten vehicles which Martin built in project.

October 14: First successful Nike-Zeus test flight.

October 17: Second successful X-15 powered flight.

October 21: Development Operations Div. of the Army Ballistic Missile Agency is transferred to NASA, subject to Congressional approval. The group is responsible for Saturn development.

October 22: Prepackaged liquid rocket engines for Bullpup and Sparrow III shown by Navy.

October 28: A 100-ft-diam aluminum sphere inflates after ejection from Sergeant rocket. Satellite to be used in Project Echo.

October 29: Advanced Mace-B is test-fired.

November 4: One ton Mercury capsule, fired to seven miles from Wallops Island, tests Astronauts' emergency escape system. . . . Atlas test-fired 6000 mi.

November 7: Discoverer VII fired into polar orbit. Electrical malfunction in rocket prevents capsule from ejecting. This causes burned-out second stage, with satellite attached, to tumble. Recovery by C-119's fails.

November 9: Air Force names Boeing to manufacture Dyna-Soar vehicle, Martin to manufacture the booster. Wright Air Development Division is systems manager.

November 10: Fire-stage "Strong-arm" rocket launched 1050 miles high from Wallop's Island to measure electron density in ICBM environment.

November 18: SNAP II 220-lb thermal reactor announced. . . . NASA launches five stage rocket.

November 20: Thor-Agena launches Discoverer VIII from Vandenberg AFB into polar orbit. Capsule ejected 26 hr after launch but apparently fell out of recovery area.

November 26: Four-stage Atlas-Able fires 372-lb Pioneer lunar probe spheroid with four solar paddles. Plastic shroud covering the probe fell off 45 sec after launch. Payload was then torn off. Radar indicated second stage ignited but there was no indication that it separated. Probe aimed at measuring three specific energy levels of cosmic rays; relaying pictures of lunar surface.

November 29: Navy balloon with two man crew rises 15 mi. Scientists make telescopic studies of water vapor in atmosphere of Venus.

December 4: Little Joe escape capsule carries a rhesus monkey (Sam) 55 mi high. Sam picked up 200 mi from launch site.

December 12: Titan explodes few feet off launching pad at Cape Canaveral. Was second explosion ruining attempt at firing live second stage.

December 15: F104-C reached 103,-395.5 ft, new world's altitude record.

December 16: Third test model of Nike Zeus fired at White Sands. Second stage failed when sustainer motor did not ignite.

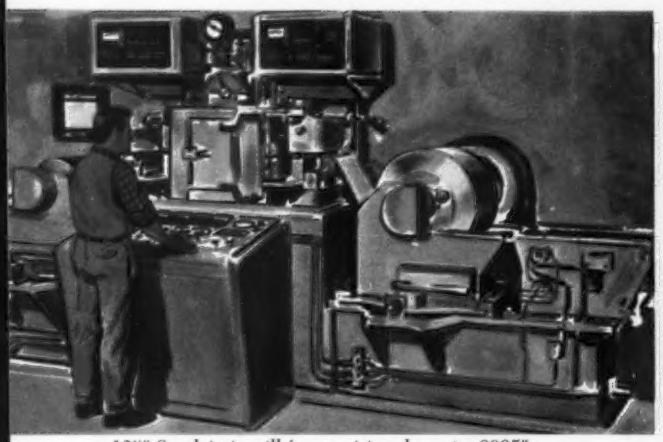
December 16: Ground-guided Snark ICBM completed third 2000 mile round trip over Atlantic Missile Range from Cape Canaveral. . . . Air Force claims 1520.9 mph world speed record for F106 Delta Dart equipped with afterburner.

December 22: Four-stage Javelin rocket shoots 48-lb payload 560 miles high. Firing from Wallops Island studies radio waves, tests new X-248 solid fuel rocket engine to be used in Scout and Delta.

December 23: Polaris fired from ship motion simulator. Sixth firing of prototype. ✦

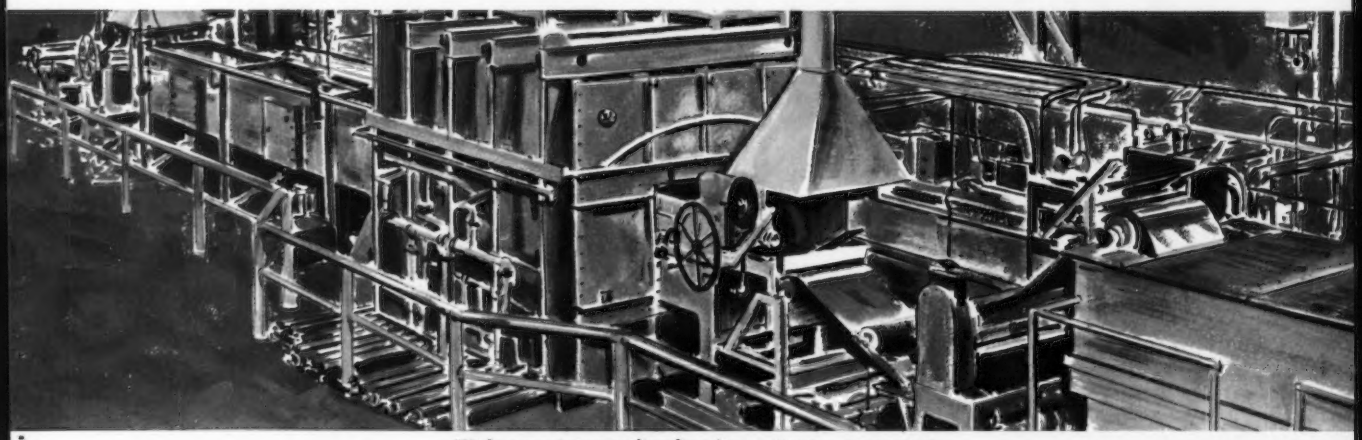
Circle 24 on Inquiry Card ⟶

25" Sendzimir mill for capacity on thinner and wider foils



12½" Sendzimir mill for precision down to .0005"

Precision slitting to custom requirements



Wide capacity annealing line for continuous processing

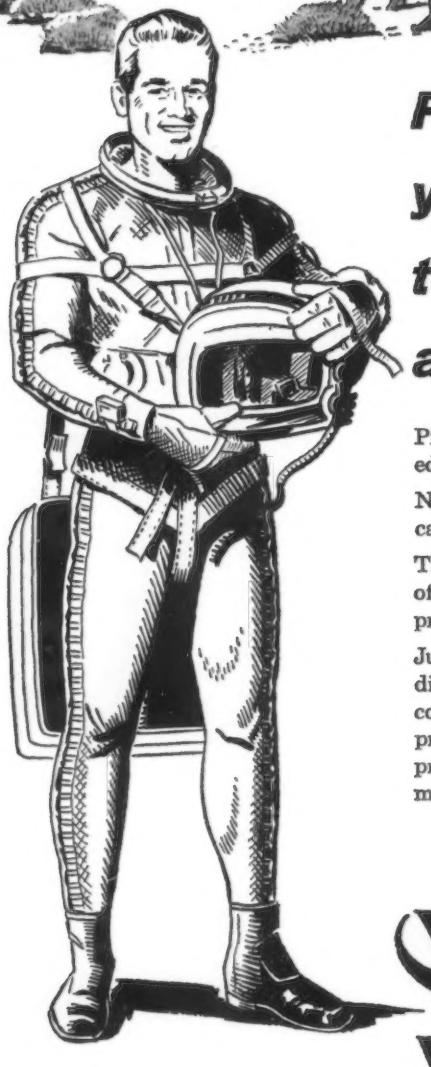
CAPACITY PLUS VERSATILITY EQUALS PERFORMANCE

RODNEY ROLLED IS QUALITY CONTROLLED

Reliable Rodney says:
Make Rodney your source for stainless and alloy strip down to .0005".

RODNEY METALS, INC., (MILL) NEW BEDFORD, MASS.
West Coast Office and Warehouse: 5462 East Jillison St., Los Angeles 22, Cal.

V-R CREATING THE METALS THAT SHAPE THE FUTURE



Pioneering... yesterday... today... and tomorrow!

Pioneering is open in many fields as man stands on the edge of space.

New metals and materials must be created to help carry him safely into space and back.

The metallurgical research and production experience of V-R refractory metal specialists can serve your program by building metals to meet your specifications.

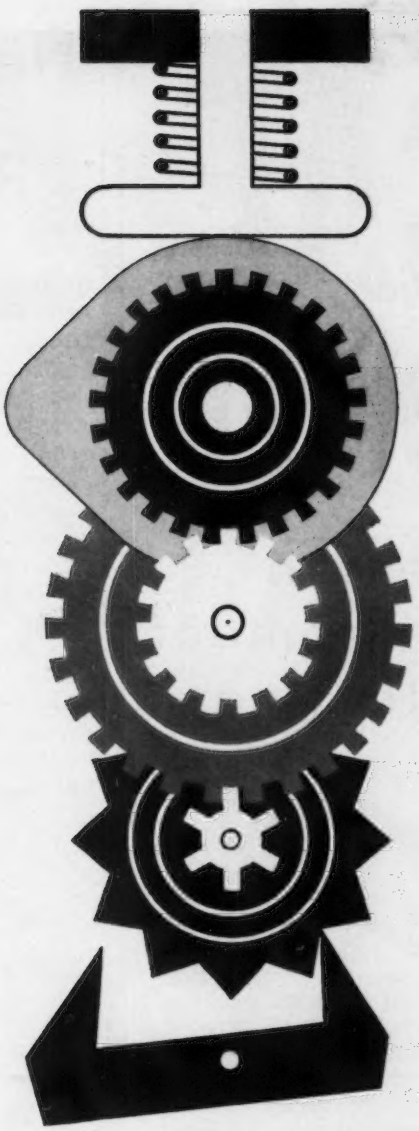
Just give us your requirements for heat resistance . . . dimensional stability . . . density . . . resistance to wear and corrosion. We may be able to help you solve some of your problems. Our metallurgical know-how and complete production facilities are working full time creating metals to help pioneer a brighter future.

V-R

VASCOLOY-RAMET

894 MARKET STREET • WAUKEGAN, ILLINOIS

A-774



Escapement mechanisms... by Bulova

Bulova engineering extends from requirement to mass production

Bulova mastery of clock escapements and precision manufacturing offers advantages in design and production of simple, rugged and inexpensive mechanisms integrating time, distance and acceleration.

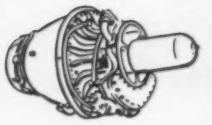
Bulova capability can make a whole lot of difference in the success and reliability of your program—commercial or military.

Experience in precision design and manufacture is the Bulova tradition—the Bulova capability—it has been for over 80 years. For more information write—

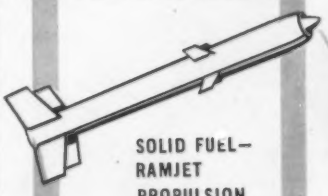
Industrial & Defense Sales, 62-10 Woodside Avenue, Woodside 77, N.Y.

BULOVA

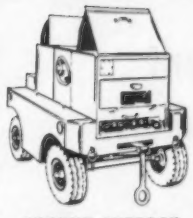
VISIT OUR BOOTH NUMBERS #1719-#1721 I.R.E. SHOW—N.Y.C.



TURBINE PROPULSION



SOLID FUEL—
RAMJET
PROPULSION



GROUND SUPPORT

CAE POWER

- Research
- Development
- Production

● Continental Aviation & Engineering Corp. is exceptionally well qualified, both by experience and by facilities, for work on the weapons systems of tomorrow. Our background embraces not only a half-century of internal combustion engine experience, but also years of pioneering in gas turbine engine development, and more than a decade in the field of solid fuels for ramjet propulsion of missiles and target drones . . . Continental is staffed and equipped for a wide range of assignments, military and commercial. The Detroit Division Research and Development Department is supported by our modern-to-the-minute Component Testing Laboratory complete with environmental facilities located at Toledo. The Toledo Production Division now producing various turbine engines in volume is capable of supporting diversified programs . . . The CAE record of achievement is one of which many a larger company might be proud. Inquiries are invited from those having propulsion problems, on the ground, on the water, in the air.

CONTINENTAL AVIATION & ENGINEERING CORPORATION

GENERAL OFFICES AND RESEARCH AND DEVELOPMENT DEPARTMENTS AT 12700 KERCHEVAL AVENUE, DETROIT 15, MICHIGAN . . . PRODUCTION DIVISION AND FIELD SUPPORT, 1330 LASKEY ROAD, TOLEDO, OHIO.

SUBSIDIARY OF CONTINENTAL MOTORS CORPORATION

New Books AND Reports

QUALITY CONTROL AND INDUSTRIAL STATISTICS. A. J. Duncan. Irwin, 1959, 946 pp. $10.80. This is an authoritative work on the basic principles and procedures of statistical quality control. It is intended for use as a textbook and reference manual; it assumes a previous grounding in statistics. At the end of each chapter a section is provided on applicable problems, and a list of selected references. The book contains five major parts. (I) Fundamentals — probability, frequency distribution, and sampling; (II) Lot Acceptance Sampling Plans; (III) Rectifying Inspection; (IV) Control Charts; (V) Some Statistics Useful In Industrial Research—estimation of lot and process characteristics.

TECHNICAL REPORTS

The following reports may be obtained from the Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C.

AIRCRAFT AERODYNAMICS (AERODINAMIKA SAMOLETA) Published by Russia's State Publishing House for the Defense Ministry in 1957; translated by the Technical Information Center, Wright Air Development Center, U. S. Air Force. The translated version appears in three volumes containing a total of 808 pages. They are Part 1-59-11993-1, price $5; Part 2-59-11993-2, $5; and Part 3-59-11993-3, $3.50.

THERMAL CONDUCTIVITY OF LUBRICATING OILS AND HYDRAULIC FLUIDS. D. W. McCready, University of Michigan Research Institute for Wright Air Development Center, U. S. Air Force. Mar. 1959. 59 pages. $1.50. (Order PB 151780).

Custom Tool and Manufacturing Company is a leader in its field, because it has always provided the *service* and *quality* that customers demand. Just as the name implies, it is set up to provide custom fabricating service on components for industry. Its specialized manufacturing facilities and highly skilled technicians can do a better job for you, whether it is producing a few prototype parts or a full production run. Here are a few of the metals and non-metallics that Custom commonly works with:

Pure Tungsten	Waspalloy	91 L D
Tungsten Alloys	Tantalum	Rockide A
Pure Molybdenum	Astrolite	Rockide Z
Molybdenum Alloys	Polypreg	Aero Rez

If your requirements are in these or any other metal or plastic material, call, write, or wire

CUSTOM TOOL AND MANUFACTURING COMPANY

2201 NORTH SECOND STREET • MINNEAPOLIS 11, MINNESOTA

Subsidiary of the Steel Improvement and Forge Company

AN **AIRCRAFT & MISSILES** SPECIAL STAFF REPORT

Inside the AIA

This long-range, industry-wide planning group saves engineer's time and taxpayer's money; How is this done? Who does the work? What can AIA do for you? Here are the answers

BOARD OF GOVERNORS

W. M. Allen
President, Boeing Airplane

A. Boyd
Vice President, Westinghouse

G. M. Bunker
Chairman, The Martin Co.

O. R. Cook
President, AIA

D. W. Douglas, Jr.
President, Douglas Aircraft

L. P. Faneuf
Chairman, Bell Aircraft

M. P. Ferguson
President, Bendix Aviation

R. E. Gross
Chairman, Lockheed Aircraft

C. G. Holschuh
Executive-Vice Pres. Sperry Rand

C. J. McCarthy
Chairman, Chance Vought

R. McCulloch
President, Temco Aircraft

J. S. McDonnell
President, McDonnell Aircraft

J. V. Naish
President, Convair

D. E. Noble
Executive VP, Motorola

G. T. Pew
President, Aero Design & Engineering

AIA OFFICERS

Chairman of the Board **J. S. McDonnell**
Vice Chairman of the Board **J. V. Naish**
President **Orval R. Cook**
Vice Presidents **Leland D. Webb**
George F. Hannaum
Secretary-Treasurer **Harrison Brand, Jr.**
Assistant Secretary **Samuel L. Wright**

EXECUTIVE COMMITTEE

Orval R. Cook **J. V. Naish**
J. S. McDonnell **W. M. Allen**
C. G. Holschuh

Most everyone within the aerospace industry knows the Aerospace Industries Association, AIA, by name. What most don't know are its purposes and functions. Here are the facts on this dynamic organization.

Primarily concerned with the industry-wide aspects of aeronautical and astronautical research, development, production and logistic support, AIA acts as the communication link between Government and the industry. By joining together the highly competitive aerospace companies, AIA has saved countless dollars for Mr. Taxpayer. How? Simply by efficient programming to foster safety, air travel, good employee relations, the dissemination of engineering knowledge, and host of other items.

Let's take a quote from Charles J. McCarthy, AIA's chairman of the board of governors. "It is more important than ever that our defense research and production programs be efficiently managed and conducted at minimal cost to the taxpayer. Among the many groups working toward defense betterment are the trade associations . . . whose behind-the-scenes efforts . . . have gone largely unnoticed. Such efforts have, in a great many cases, brought about large-scale savings, an important factor in an era when it is imperative that we obtain maximum defense for every dollar spent."

Birth and Growth—To better understand the workings of AIA, we have to go into a brief historical sketch.

Back in '17, aircraft production problems, there were many, were solved by the companies within the industry joining forces. At that time the group called itself the Manufacturers Aircraft Association. After the war, the name changed to Aeronautical Chamber of Commerce.

During WWII, the government set up Aircraft War Production Councils (AWPC) to achieve efficiency in turning out the mass number of aircraft needed. At the end of hostilities, the Aeronautical Chamber of Commerce took over many of the Functions of the AWPC's. Thus, a new name came into being—Aircraft Industries Association. Another aim was added. This time it was to gather, consolidate, and pass on to the industry engineering knowledge.

Last year, because of the growing stake in missiles and space for the aircraft firms, the name was changed to Aerospace Industries Association. Although, the name has varied over the years, the purposes are still the same. Also, the organization can function on a moment's notice in the role of the AWPC in the event of national emergency.

Who are the members? Just whom you might expect. Primarily, members of the Aerospace Industries Association of American, Inc., (that's its official handle) are makers of aircraft, missiles, engines, parts, components, materials, and accessories.

AIA is run by a board of governors composed of the chief executives of member companies. However, all of the members take an active part in establishing the policy. There are 42 committees and councils consisting of 1900 specialists with high-level company positions. These people have done much to bring about new methods and procedures so that we might have better aircraft and missiles at less cost.

Help For Engineers—Perhaps the major interest area to engineers is AIA's technical service group. This is where AIA can help you. For example, projects in which

H. M. Horner
Chairman, United Aircraft

L. A. Hyland
Vice President, Hughes Aircraft

D. A. Kimball
President, Aerojet-General

J. H. Kindelberger
Chairman, North American Aviation

T. A. Knowles
President, Goodyear Aircraft

C. W. LaPierre
Executive Vice Pres. General Electric

M. I. Peale
President, Republic Aviation

C. J. Reese
President, Continental Motors

J. E. Rheim
President, Rohr Aircraft

T. C. Ryan
President, Ryan Aeronautical

D. L. Wallace
President, Cessna Aircraft

A. M. Wilson
Executive Vice Pres., Minneapolis-Honeywell

How committee work has been translated directly into dollar savings

AIA SPONSORS EDUCATION through the National Aviation Education Council, a non-profit organization. Primary aim is to advance aerospace curriculums in the schools. Illustrated are some of the materials published by the Council.

WIDELY QUOTED AIA publication "Aerospace" is circulated to industry, government officials, and over 10,000 libraries. Formerly called "Planes," the new name reflects changing manufacturing emphasis of the industry.

AIA's technical groups made major contributions include:

1. Preparations of an annual five to 10 year forecast of engineering and manufacturing trends and requirements. This document represents the thinking of industry's top people in design, production, and materials.

2. The development of a new system for machining complex aircraft and missile parts which offers savings in skilled man-hours of 80 to 95 per cent. The system, called APT for Automatically Programmed Tool (see A&M May 1959) was developed as joint effort of the USAF Air Material Command, Massachusetts Institute of Technology and technical representatives of 19 AIA member companies. Now, refinements are being made for greater productive efficiency under the management of the APT Project Coordinating Group of AIA's Numerical Control Panel.

3. Preparation of another document entitled "The MILDDU Proposal," which, despite its unwieldy title, is an important contribution to the increasingly complex problem of logistic support. MILDDU is a program which would provide a universal standard for military-industry support data interchange, increase the accuracy of spare parts accounting, reduce over - purchase of spares and improve the speed and efficiency of providing needed spares at the right time.

These are just a few examples of how AIA's work promotes more efficient defense programming and production. Daily, the 1900 members of the 42 AIA committees are studying present and anticipated problems in hundreds of areas. The data assembled by these committees is available to the Department of Defense, the Army, Navy and Air Force, the National Aeronautics and Space Administration, the Federal Aviation Agency and other interested governmental agencies. Collectively, the results of this unheralded "pick-and-shovel" work produces a fount of knowledge of

inestimable value to the nation's aerospace programs.

Committees At Work—The activities of the 42 AIA committees are so broad that it is difficult to explain in general terms how important a contribution they make. Some indication of the type of work in which they engage may be gathered from the titles of a selected few of the committees:

- Quality Control Committee, which develops policies, procedures and recommendations to insure continuing improvement in product performance and reliability.
- Manufacturing Committee, which seeks to obtain more efficient manufacturing methods equipment, processes and techniques.
- Spare Parts Committee, which is concerned with reducing spare parts requirements and streamlining logistic support.
- Guided Missile Council, concerned with research, design, development and construction of missiles, with special emphasis on reliability.
- Aircraft Research and Testing Committee, which deals with applied research and testing of new structures, materials and processes and exchange of information in these areas.

Turning to the specific will give a better indication of how these committees contribute to defense efficiency and cost reduction. The Spare Parts Committee has a membership of 125 managers and assistant managers of spare parts departments representing all segments of the industry.

For the past 15 years, the committee has worked closely with the military services, coordinating and making recommendations in the development of procedures for provisioning spare parts, special tools, test and ground handling equipment and training aids.

Recently, the Air Force reported that weapon system support has been reduced in spares from 43 per cent of the aircraft program in 1952 to 23.5 per cent in 1959. The committee was commended for its contributions to this result.

Text continued on page 108

TECHNICAL COMMUNICATION between industry and government is one of AIA's primary purposes. Each year manuals on design, development and production methods, techniques and procedures are published by the Association.

AERONAUTIC AND ASTRONAUTIC charts and booklets are published for teachers in elementary schools. Explaining various subjects, AIA hopes to interest the young in aerospace careers.

A.I.A. ORGANIZATION CHART OF OFFICERS,

COUNCILS AND COMMITTEES

PRESIDENT, (General Manager)

Orval R. Cook

ACCESSORIES AND EQUIPMENT
Donald L. Cauble
Chief Engineer
Aviation Division
Sundstrand Corp.

ADMINISTRATIVE ENGINEERING
R. S. Cail
Chief General Projects
Engineering
Hamilton Standard Div.
United Aircraft Corp.

AIRCRAFT RESEARCH AND TESTING
R. S. Ross
Manager
Aeromechanics R & D
Goodyear Aircraft Corp.

AIRCRAFT TECHNICAL
D. E. Burleigh
Manager
Engineering Administration
Beech Aircraft Corp.

AIRWORTHINESS REQUIREMENTS
Bryce L. Carter
Airworthiness Engineer
Transport Division
Boeing Airplane Co.

ELECTRONIC EQUIPMENT
J. L. Bowers
Assistant Chief Engineer
Astronautics Division
Convair

ELECTRONIC PARTS
Fred Dreste
Director, Reliability
and Components Group
Motorola, Inc.

ENGINE
Chairmanship rotates

ENGINEERING CONTRACT REQUIREMENTS
D. H. Mason
Chief, Engineering Data Operations
North American Aviation

EQUIPMENT SPECIFICATION
J. M. Glass
Head, Engineering,
Standards Office
Hughes Aircraft Co.

EXPORT
L. E. Tollefson
Washington Representative
Douglas Aircraft Co.

EXPORT ADVISORY
Eastern Chairman
Robert W. Douglass
New York Representative
United Aircraft Export
United Aircraft Corp.
Western Chairman
W. J. Kane
Transport Division
Manager Export Sales
Boeing Airplane Co.

EXPORT FINANCE
Eastern Chairman
J. J. O'Shea
Treasurer, United Aircraft Export
United Aircraft Corp.
Western Chairman
E. M. Constable
Assistant Treasurer
Lockheed Aircraft Corp.

EXPORT MILITARY AID
E. W. Virgin
Eastern Representative
North American Aviation

EXPORT MILITARY AND CIVIL LIAISON
T. N. Labash
International Division
General Electric Corp.

EXPORT SURPLUS DISPOSAL
C. E. Roberts
Washington Representative
Boeing Airplane Co.

FLIGHT OPERATIONS SAFETY
P. M. Prophett
Assistant Chief Engineer
Flight Test
Convair

GOVERNMENT REPORTS
William Hummel
Contracts Division
North American Aviation

GUIDED MISSILE COUNCIL
E. P. Wheaton
Vice President
Douglas Aircraft Co.

HELICOPTER COUNCIL
Harvey Gaylord
President
Bell Helicopter Corp.
Bell Aircraft Corp.

INDUSTRIAL RELATIONS ADVISORY
James D. Esary, Jr.
Corporation Manager
Labor Relations
Boeing Airplane Co.

INDUSTRIAL SECURITY
W. M. Todd
Director, Plant Protection
Lockheed Aircraft Corp.

MANUFACTURING
K. F. Mundt
Vice President
Manufacturing
Aerojet-General Corp.

MANUFACTURING CONSERVATION
R. O. Wenger
Conservation Gen. Coord.
Norair Division
Northrop Corp.

MANUFACTURING EQUIPMENT
A. Cervenka
Chief Equipment and Process Engineer
Grumman Aircraft

MANUFACTURING TEST EQUIPMENT
Vernon D. Erickson
Assistant Chief
Electrical and Electronics
Douglas Aircraft Co.

MATERIALS PROCUREMENT
E. D. Carter
Director, Material and Procurement
The Martin Co.

NATIONAL AIRCRAFT STANDARDS
G. T. Waite
NAS Representative
Convair

PRESERVATION AND PACKAGING
D. R. Snelling
Superintendent
Pkg., Pres. and Ship. Unit
Boeing Airplane Co.

PROCUREMENT AND FINANCE
Earl Uhlig
Vice President, Finance
The Martin Co.

PROPELLER
T. B. Rhines
Chief Engineer
Hamilton Standard Division
United Aircraft Corp.

COUNCILS, COMMITTEES, AND STAFF

Vice President, Leland D. Webb
Vice President, Ass't. General Manager & Director Industry Planning Service, George G. Hannaum
Secretary-Treasurer (Business Manager), Harrison Brand, Jr.
Legislative Advisor, Harold G. Moiser
Assistant Secretary, Samuel L. Wright

STAFF

PATENT
S. G. Faber
Kollsman Instrument Corp.

PROPULSION
D. Cochran
General Manager
Flight Propulsion
Laboratory Department
General Electric Co.

PUBLIC RELATIONS ADVISORY
A. M. Rochlen
Vice President
Douglas Aircraft Co.

QUALITY CONTROL
John T. Bailey
Director of Quality
Weapon Systems
Bell Aircraft Corp.

ROCKET
Chairmanship rotates

SERVICE PUBLICATIONS
Keith R. Clark
Manager, Support Services
Baltimore Division
The Martin Co.

SPARE PARTS
J. M. Bird
Spares Manager
Seattle Division
Boeing Airplane Co.

TOOLING
K. H. Boucher
Chief Tool Engineer
Douglas Aircraft Co.

TRAFFIC
Eastern Chairman
R. H. Ross
General Traffic Manager
Allison Division
General Motors Corp.
Western Chairman
R. R. Krueger
Traffic Manager
Santa Monica Division
Douglas Aircraft Co.

UTILITY AIRPLANE COUNCIL
James R. Kerr
President
Lycoming Division
AVCO Corp.

PUBLIC RELATIONS SERVICE

Public Relations Advisory Committee
Director, Burton E. English
Assistant Director, Ben S. Lee
Director of Publications, Gerald J. McAllister

UTILITY AIRPLANE COUNCIL

Manager, Joseph T. Guting, Jr.

HELICOPTER COUNCIL

Director, Don Ryan Mockler

INDUSTRY PLANNING SERVICE

Director, George F. Hannaum
Assistant Director for Maintenance Support, T. G. Haertel
Service Publications Committee
Assistant, John W. Stahl, Jr.
Spare Parts Committee
Assistant Director for Procurement & Finance, R. W. McMillan
Procurement & Finance Committee
Patent Committee
Staff Assistant, James B. Cahill
Industrial Relations Advisory Committee
Industrial Security Committee
Staff Assistant, Edward B. Hincks
Government Reports Committee
Statistician, Teressa Smith

TRAFFIC SERVICE

Traffic Committee
Director, Harry R. Brashear
Assistant Director, Allen J. O'Brien

TECHNICAL SERVICE

Director, Samuel D. Daniels
Aircraft Technical Committee
Manufacturing Committee
Powerplant Manufacturing Committee
Materials Procurement Committee
Staff Assistant, George S. Garrard
Propulsion Technical Committee
Engine Committee
Propeller Committee
Rocket Committee
Staff Assistant, J. M. Houston, Jr.
Electronics Equipment Technical Committee
Staff Assistant, Richard M. Oliver
Quality Control Committee
Process Quality Control Committee
Guided Missile Quality Control Committee
Preservation & Packaging Committee
Staff Assistant, James F. Phillips
Guided Missiles Committee
Accessory & Equipment Technical Committee
Staff Assistant, William A. Simpson
Airworthiness Requirements Committee
Flight Operations Safety Committee
Staff Assistant, J. Zuke, Jr.
National Aircraft Standards Committee
Engineering Contract Requirements Committee

EXPORT SERVICE

Export Committee
Director, Irving H. Taylor
Assistant to Director, Marshall J. Garrett

WESTERN REGION OFFICE

Vice President and Manager, Leland D. Webb
Procurement & Finance Committee
Theodore Grant
Industrial Relations Committee
Industrial Security Committee
H. D. Moran
Aircraft Research & Testing Committee
J. A. Maurice
Airframe Manufacturing Equipment Committee
Airframe Manufacturing Tooling Committee
Manufacturing Test Equipment Committee
Manufacturing Conservation Committee
F. A. W. Stiefler
Public Relations Advisory Committee

What the technical service group has done for engineers

Department of Defense has been urged by the Guided Missile Council to establish policies for the debriefing of contractors following loss—by that contractor—of any major contract award. This was based on the experience of firms, who had been debriefed, and found it most advantageous. Actually, many companies with prime missile contracts are already holding debriefing sessions with subcontractors who have lost a subcontract award.

Also, the Guided Missile Council requested that DOD set up an industry plan for the voluntary exchange of information on testing of unclassified missile components that have proved to be satisfactory. A congressional report stated that such an exchange would be most desirable. DOD tabled the industry recommendation.

Another area in which the Guided Missile Council has been working is on reliability of our missile systems. The Council has advised DOD of industry's view on the effectiveness of the Defense Reliability Monitoring Program. The view is this: although DOD's document was welcomed as a policy guide, it cannot assure reliability prediction to the statistical, defensible accuracy implied in the document.

For five years the Quality Control Committee worked on a tedious review of quality control systems requirements, serving as an assistant group to the Department of Defense. This work contributed to the publication, earlier this year, of a new Department of Defense standard quality control system specification, an important advance in DOD's Standardization Program.

The committee was cited for its "generosity, wise counsel and long experience" by Assistant Secretary of Defense (Supply and Logistics) Perkins McGuire. He commented, "You can be sure that your work has strengthened substantially the industry-defense production team."

AIA's Traffic Committee has been able to save the government considerable sums in the shipment of aircraft and missile parts and components. For instance, builders of guided weapons have been shipping parts in large quantities to missile sites by truck. This large-volume shipping is expensive, but recently a "watchdog" group of the Traffic Committee decided that trucking costs for the missile shipments were disproportionately high. At a conference with trucking officials, a protest backed by strong arguments was made. The truckers conceded that a lower rate was in order.

Due to the size of such shipments, even a small reduction in the truckload rate brings large savings. One company estimated that the rate drop in this case brought savings of over $100,000 for parts shipments to seven missile sites over a six-month period. Future shipments will increase the savings figure, and, of course, there are a great number of other missiles and other sites, compounding the cost reduction.

In another instance, the Traffic Committee reduced costs by having manufacturers consolidate small shipments. Aircraft plants on the West Coast were able to effect substantial savings by pooling their less-than-carload shipments to take advantage of carload rates. This simple operation saved a single company $100,000 annually. The savings are reflected in the overall cost of the equipment to the government.

Another illustration of the type of service provided by the AIA committees lies in the work of the Aircraft Research and Testing Committee on Project 4-58, a cooperative investigation of the properties and engineering characteristics of a promising new alloy. This material had received widespread recognition as presenting a number of advantages in higher temperature aluminum structures.

ARTC sponsored a specialists meeting, during which it was estimated that the investigation and the compilation of the necessary engineering data would require approximately 7000 man-hours of testing, data reduction and report

TASK GROUP on procurement legislation of the 15-man Procurement and Finance Committee is typical of the many ad hoc working committees of AIA. Chairman of the group is John Roscia, North American Aviation. AIA representative, Robert McMillan, sits at upper left facing front. Such groups are meeting almost daily in an effort to solve problems.

writing, conservatively estimated at $10 per hour. ARTC brought about a cooperative program whereby 16 AIA member companies are contributing about 450 man-hours each for the task.

The committees make another important contribution in the matter of forecasting specific industry requirements. The pace of product development and the rapid change in engineering characteristics make it imperative that the changing needs of the industry be promptly communicated to these groups serving the aerospace industry—suppliers, vendors, subcontractors, etc. —who can then channel their own development programs into appropriate lines. For instance, Report ARTC-14 stated distinct new needs in 4340 steels. At the time the report was published, the requirements could not be met by any of the steel mills. Six months later, as a result of wide dissemination of the report to the steel industry, at least a half-dozen warehouses were stocking 4340 products meeting the new requirements.

A series of performance and basic design standards for a complete family of metal removal machinery, tailored specifically to the requirements of the aircraft and missile industry were started by the Equipment Committee. This continuing program embraces a plan of close coordination with all affected elements of industry as well as government agencies responsible for lot purchases. Substantial reduction of delivered-product costs have accrued to the government through the availability of machinery and equipment designed to accomplish a specific fabricating task as opposed to modifying standard equipment initially designed for automotive and heavy industry.

The foregoing represent just a view of the hundreds of examples of how the AIA staff, which serves as a secretariat for the committees, and the membership of the various committees, are contributing to a more efficient defense program.

The function of AIA as a communications link between government and industry fills an important need in efficient defense management, and, as a defense official once stated, "If such an organization did not exist, it would have to be created."

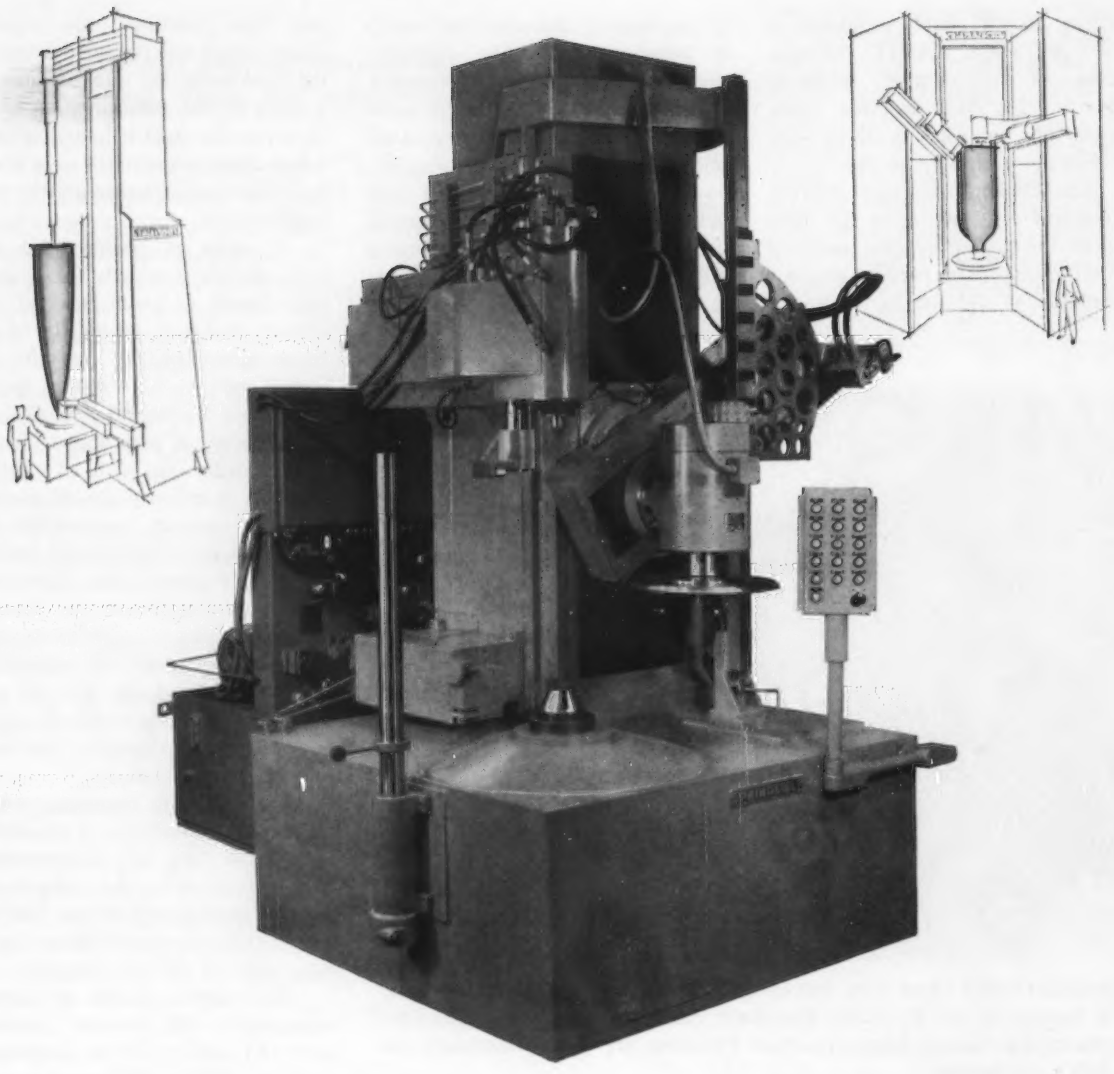
◆

TOP EXECUTIVES of AIA, left to right, Sam Daniels, Director of Technical Service, Orval R. Cook, President, Harrison Brand, Jr., Secretary-Treasurer, and George Hannaum, Vice President, are shown discussing one of AIA's publications.

A PRIMARY PURPOSE of AIA is to devise more efficient and economical methods of manufacture. The complexity of products involves, what some might think, splitting hairs. Here is a project meeting of the Electronic Parts Committee concerned solely with wire specifications.

A REPRINT

of this article can be obtained by writing on company letterhead to The Editor, AIRCRAFT & MISSILES Chestnut & 56th Sts., Phila, 39, Pa.



Vertical Grinding missile shapes

If you have anything to do with contoured missile shapes you should find out about this brand new breed of machine —the vertical contour grinder. The machine shown above turns and grinds a laminated missile nose whose surface must be smooth and accurate. The point is, this machine was designed for specific missile requirements, and yours may be similar. In vertical grinding the force of gravity works to help achieve concentricity, uniform wall thickness, accurate interior and exterior contours and extreme micro-inch finish. These grinders are designed especially for ceramic, metal, plastic and combinations of materials. Size and weight of workpiece is not limited.

The Springfield Machine Tool Company pioneered the principle of vertical grinding and was one of the first builders to incorporate the principle of hydraulic contouring in a machine tool. These ideas are found in hundreds of machines bearing the Springfield nameplate, and are your best assurance that we can bring to your problem both experience and imagination. Telephone, telegraph or write for informative literature.

THE SPRINGFIELD MACHINE TOOL CO., SPRINGFIELD, OHIO

SPRINGFIELD

complex jet engine componentry

This complete jet turbine wheel is a product of Kelsey-Hayes, Jackson, Michigan plant. Its high standards of performance reflect Kelsey-Hayes' capabilities in the production of crucial rotating machinery, components and assemblies.

As a major subcontractor to the aerospace industries, Kelsey-Hayes' capabilities also include the production of vacuum-induction-melted alloys, as well as design, development and production of advanced thrust vectoring devices.
Kelsey-Hayes Company,
Detroit 32, Michigan.

KELSEY HAYES COMPANY

Automotive, Aviation and Agricultural Parts
Hand Tools for Industry and Home

18 PLANTS: Detroit and Jackson, Michigan; Los Angeles; Philadelphia and McKeesport, Pennsylvania; Springfield, Ohio; New Hartford and Utica, New York; Davenport, Iowa; Windsor, Ontario, Canada.

THE MARK OF QUALITY

BARBER COLMAN

AIRCRAFT AND MISSILE ACCESSORIES

Custom-designed or standard types for wide range of applications

Temperature Controls

Cycling — proportioning — floating; electronic . . . transistor . . . polarized relay . . . and magnetic amplifier types for military, commercial, and business aircraft. Barber-Colman is also the exclusive producer of CEDAC cooling effect detection and control systems.

Positioning Controls

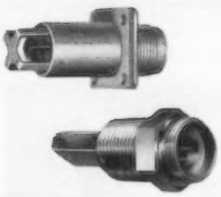
Integrated, highly sensitive remote positioning systems designed to your specifications. Magnetic amplifier, electric, and electronic types. Anti-hunt feature provided by unique circuitry.

Air Valves

Electrically and pneumatically operated for temperature and pressure-control applications. Butterfly . . . check . . . poppet . . . and automatic drain types. Metallurgically proved materials and precision machining assure long, trouble-free operation. Inquiries invited for missile applications.

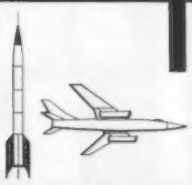
Electromechanical Actuators

Rotary and linear types featuring a wide range of gear reductions, switching, mounting details. The complete Barber-Colman line includes new lightweight, compact actuators for extra space-saving, weightsaving advantages.



Transducers and Thermostats

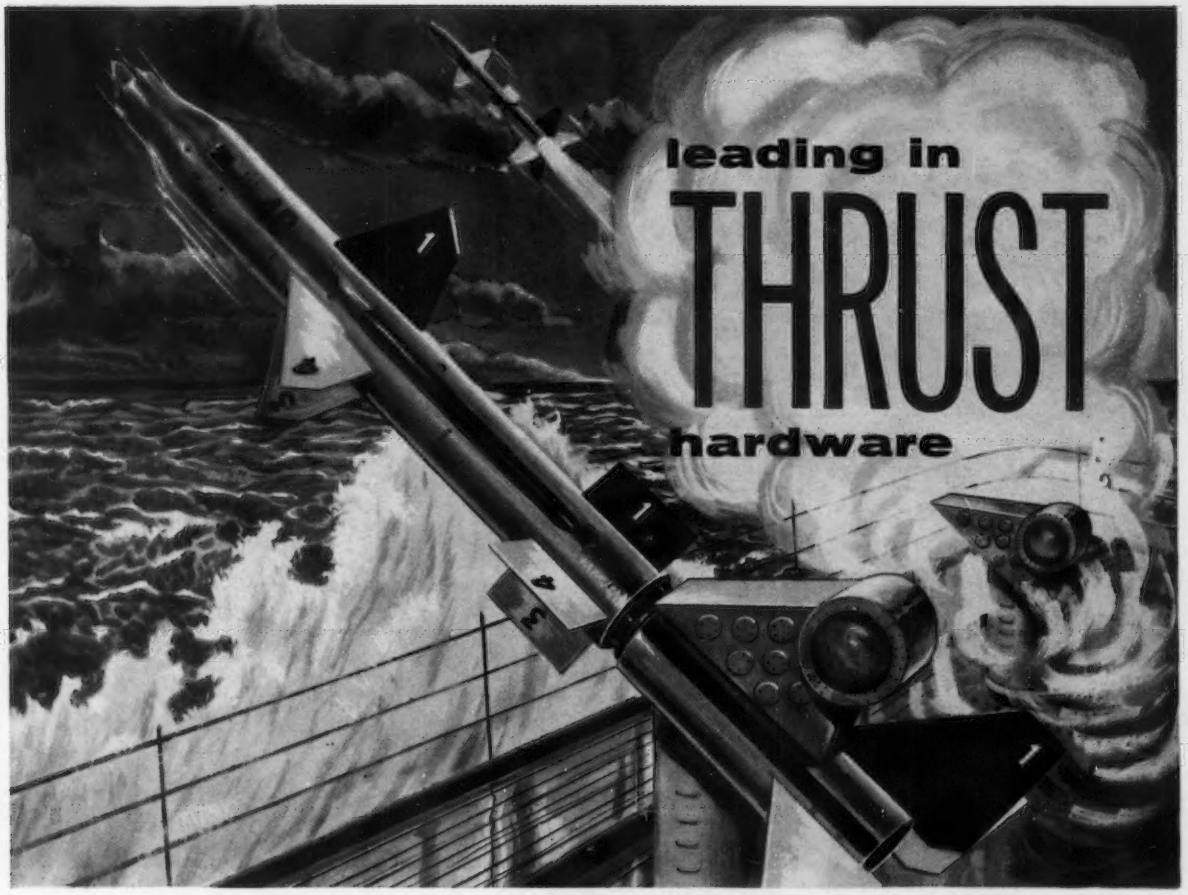
Units for sensing compartment, duct, and windshield temperatures. CEDAC detectors for sensing temperature and/or airflow.



For expert assistance on your control projects, consult the Barber-Colman engineering sales office nearest you: Baltimore, Boston, Fort Worth, Los Angeles, Montreal, New York, Rockford, Seattle.

BARBER-COLMAN COMPANY

Dept. C, 14109 Rock Street, Rockford, Illinois



LET'S GET DOWN TO CASES ... ENGINE CASES

Engine cases, boosters, and sustainers are now in production for the Talos, Terrier, Snark, and Pershing missiles.

High strength cases such as the one at the left of 16″ dia. x 48″ long x .050″ wall thickness have been fabricated and consistently burst at strength levels from 280,000 psi to 325,000 psi dependent upon the draw temperature used.

Whether you need a bid on an operational assembly, or help with an R & D item, Ingersoll Kalamazoo Division engineers and facilities are ready.

...325,000 PSI

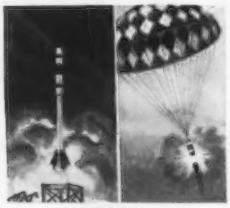
Borg-Warner Corporation

ENGINEERING B-W PRODUCTION

INGERSOLL KALAMAZOO DIVISION

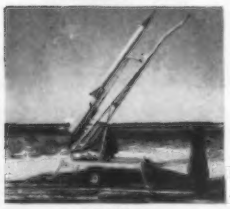
KALAMAZOO, MICHIGAN

8442-AC



POGO-HI
(II E3c)

P-107
AIR LAUNCHED



P-106
GROUND LAUNCHED

AERONCA TARGET MISSILES PERFORM A VARIETY OF MISSION PROFILES... WITH SUBSTANTIAL ECONOMY

The adage "practice makes perfect" keynotes today's concept of missile warfare. Against supersonic targets, there isn't time for "the second barrel". Therefore, extensive operational testing of air defence systems . . . and training programs for personnel who operate them . . . must be conducted to assure national preparedness.

To accomplish this requirement at minimum cost, Aeronca has developed two expendable, lightweight, high-performance target systems under the Design-Tool-Produce envelope concept. These proprietary missile programs, the P-106 and P-107, are designed for supersonic performance and accurate scoring at all required altitudes, speeds and ranges. *And their production cost is projected to be substantially less than any current target missile system!*

Another Aeronca-produced missile project is *Pogo-Hi II E3c.* Ground launched to high altitudes, this target utilizes a radar reflective parachute and an infrared emitter package. It is used as "bait" for such current projects as *Nike, Talos, Sidewinder* and *Falcon.*

With integrated Design, Tooling and Production capabilities, Aeronca can produce weapon systems envelopes at either prime or subcontractor levels.

AERONCA manufacturing corporation
1726 GERMANTOWN ROAD • MIDDLETOWN, OHIO

Operational expansion has created openings for additional senior engineers. Write to W. W. Gordinier, Personnel Manager.

AIRCRAFT & MISSILES

1960

GUIDANCE SYSTEMS

One of the more complicated systems in any advanced missile is the guidance. Sometimes called the "brain" of the missile, it is the "think" that puts the payload on target. The ultra-accurate manufacturing standards, and meticulous cleanliness that are associated with the missile industry reach their peak in guidance. It is also in this system, with its complex ground checkout and monitoring devices, that the mushrooming colossus—electronics—finds greatest application.

The basic principles of the many guidance schemes in use are reviewed here. Simple, block diagrams of each system are provided for the "non-guidance men" who need at least a casual knowledge of the way various guidance systems function.

Guidance—a Summary Report

SOME MAJOR GUIDANCE MANUFACTURERS

Company	Guidance Identifier	Type	Company Responsibility	Missile Using
A. C. Spark Plug Div. General Motors Corp.	AChiever	All-inertial	Prime (entire system)	Thor, Titan, Mace
Advanced Technology Laboratories	Vertical Reference System	Infra-red	Subcontractor (horizon scanner)	Discoverer
American Bosch Arma Corp.		All-inertial	Prime (computer, stable platform, control central)	Atlas
Babcock Radio Engineering Inc.	AN/ARW-66	Radio-Command	Prime & Subcontractor	KD2R-5, Navy Target Aircraft
	AN/USD-1	Radio-Command	Prime & Subcontractor	AN/USD-1, Signal Corp, Surveillance Aircraft
	AN/SRW-4	Radio-Command	Prime	DKA, DKB, DK2R-5 F6F, F9F (drones)
Bell Aircraft Corp.	Hipernas I, II	Inertial	Prime (entire system)	
Bendix Aviation Corp.	"Pershing"	Inertial	Stable Platform	Pershing
	"Talos"	Beam-rider & Homing	Prime (entire system)	Talos
Burroughs Corp.	AN/GSQ-33	Radio-Command	Prime (entire computer)	Atlas, Atlas-Able, Thor-Able
Chicago Aerial Ind.	Solo	Optical Homing	Entire System	
Ferranti-Packard Elec. Ltd.	Type A/C, B/C	Inertial	Prime (gyros)	CF-100, T33
General Electric Co.	"Sidewinder"	IR Seeker	Prime	Sidewinder
	"Titan"	Inertial	Subcontractor (instrumentation)	Titan
	"Atlas"	Radio-Command	Subcontractor	Atlas
	"Polaris"	Inertial	Subcontractor	Polaris
	"WS-117L"	Command	Subcontractor	WS-117L
	"Atlas Series"	Command	Subcontractor	Atlas-Able, Atlas Mercury
Gilfillan Bros., Inc.	"Corporal"	Command	Prime (electronics)	Corporal
Kearfott Co., Inc.	"Subroc"		Prime (entire system)	Subroc
	Bomarc-B		Prime (mid-course all attitude system)	Bomarc-B
Librascope Div. of General Precision Inc.	ASN-24 (computer)	Inertial	Subcontractor	Centaur
Minneapolis Honeywell Regulator Company	"Polaris"	Inertial	Entire System	Polaris
	"Centaur"	Inertial	Entire System	Centaur
	"Scout"	Inertial	Entire System	Scout
	"WS-117L"	Inertial	Entire System	WS-117L
	"Thor-Delta"	Inertial	Entire System	Thor Delta
	"609A"	Inertial	Entire System	
	"Titan"	Inertial	Subcontractor (accelerometers)	Titan
	"Bomarc"	Homing	Subcontractor (accelerometers)	Bomarc
	"Atlas"	Inertial	Subcontractor (gyros)	Atlas
	"Thor"	Inertial	Subcontractor (gyros)	Thor
	"Minuteman"	Inertial	Subcontractor (gyros)	Minuteman
	"Sergeant"		Subcontractor gyros and accelerometers	Sergeant
	"Houndog"			Houndog
Nortronics Div. Northrop Corp.	Mark I	Astronertial	Subcontractor	Snark
	A-5	Astronertial	Subcontractor	GAM-87A (Air-launched Ballistic Missile)
Philco Corp.	"Sidewinder"	IR Seeker	Prime (entire system)	Sidewinder
Radioplane Div. Northrop Corp.	RPTA-1	Command (inertial)	Prime (airborne & ground equipment)	RP-76 target missile RP-77D target
Republic Aviation Corp.	"Bullpup"	Command	Subcontractor (acquisition unit, command computer)	Bullpup

The term guidance is generic for a variety of schemes that have come into being to put a missile on target. Not all guidance systems function during the entire flight of the missile. The actual point in the flight where the guidance does function, determines whether it is called initial, midcourse, terminal, or HATW (homing all the way).

Just about all of the systems now in use can be classified in two categories: electronic, and mechanical. Electronic guidance reacts to microwaves and heat (infrared) waves to put the missile on target. It derives information from the target itself, either directly or indirectly. Mechanical guidance reacts to changes in a preset flight path. It is independent of information derived from the target after launch.

There are all sorts of variations on these two classifications. And, there are combinations of the variations. Eight of the fairly common variations are reviewed and explained: (1) Beam rider, (2) Celestial, (3) Celestial-inertial, (4) Command, (5) Homing, (6) Inertial, (7) Radio-inertial, (8) Terrestrial-reference.

Role of Control—Control and guidance are usually closely allied in a missile. But, the two are not synonymous. Oversimplified, guidance gets the missile from Point A to Point B; control sees to it that "orderly" flight is maintained along the way. It is extremely difficult in some cases to clearly distinguish between the two. In mechanical guidance, for example, the same components can perform guidance and control. Gyroscopes are used to stabilize (or control) the missile on its various axes. One of these axes could lie directly along the pre-programmed flight path. When a force acts to move the missile off

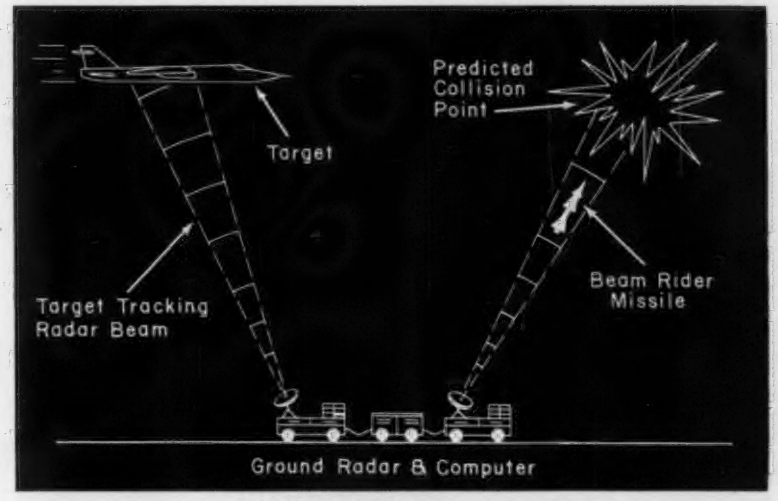
the path, the gyro senses it and generates an error signal. This signal is usually electrical and in turn activates a servo mechanism to correct the deviation from course. In this case, guidance errors in azimuth can be regarded as stabilization errors in control.

Beam-rider—This kind of guidance is used largely in surface-to-air, and air-to-air intercepts. The missile follows a radar beam which "illuminates" the target. Equipment is built into the missile to determine when it deviates from the center of the beam and takes corrective action to get back on course. This beam is not to be confused with the radar which actually tracks the target (see illustration). The tracking radar predicts the intercept point by projecting the target's course. It then shoots a beam (which the missile rides) out in space to the intercept point. This kind of guidance is usually confined to midcourse, but can be continued to intercept.

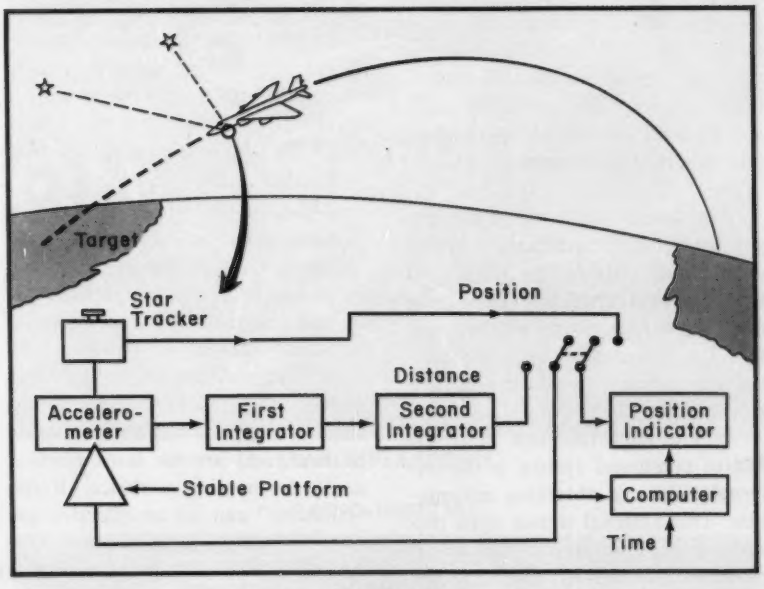
Since the missile is in the beam continuously, antenna requirements are not severe. A pair of cylindrical lenses, or tapered plastic rods placed at opposite ends of the missile suffice.

A one-radar system is used in the air-to-air version. The launch craft, missile, and target have to remain in a straight line.

Because of its limited capabilities, the beam-rider guidance is an interim system.



BEAM-RIDER



CELESTIAL

Celestial—Long range guidance has entirely different problems than short range guidance. One method of achieving long-range guidance is through the celestial system. It is highly complex. It consists basically of a mechanism that takes star fixes, and through electronic conversions, keeps the missile on course.

A simple explanation of the method is: (1) The course is predetermined and missile is launched, (2) A star-tracking telescope takes fixes on predetermined stars, (3) Information is fed into electronic computers which determine if there is deviation from course, (4) Corrective controls are activated by error voltages developed when the geographic point does not coincide to that prescribed.

It is obvious that missiles using this guidance must fly at high altitudes, above all weather. Or, must be used only in clear weather. The Snark missile was one of the first to use celestial guidance successfully.

Celestial-Inertial—A system of celestial navigation where an inertial system is supervised by continuous fixes is referred to a astro-inertial or celestial inertial. One approach is the Stellar Supervised Inertial Autonavigator (SSIA) and another is the Automatic Celestial Navigator (ACN).

In the former, periodic star shots are taken to check on gyro drift. This gyro check is necessary because of an unpredictable "random drift" in gyros. In a one hour flight this would cause an error of about 1 mile at target. An auto-

An elementary engineering analysis of the various guidance schemes in use

matic sextant on a stable platform takes the star shots. Azimuth and elevation precision-torquers position the sextant. Positioning system receives its signals from a prerecorded tape for the entire flight.

The stellar supervised inertial system can fly under clouds for a long time without serious effect if adequate gyros can be perfected.

The ACN uses one or more sextants on the platform to overcome the limitations of SSIA. With several sextants operating continuously, a series of actual fixes are obtained. The single sextant method gives only LOP. Unfortunately the multiple sextant layout requires a large window. This would be subject to great flexures at high speeds and severe environments.

Command—Data about the target and actual guidance control come from outside the missile in the command systems. The missile contains a receiver to pick-up signals (or commands) from the controlling source. Control surfaces are activated by these commands.

The important link in an effective command system is the external means of obtaining information. This external source must distinguish between desired and actual position, and rapidly command the proper amount of correction. The link can be visual or electronic. In some cases TV augmentation is used. The command signal can also be transmitted in many ways. The more simple field weapons still use a wire physically attached to the missile. Electronic (radar) means are used in more advanced concepts. This eliminates the requirement of target visibility.

A later development in command guidance uses a combination of command and tracking radar in the capacity of a command link. A beacon receiver is used in the missile as the command receiver. This eliminates one of the usual links and increases reliability of the overall system.

The command systems are the natural evolution of what was originally called "remote control." The target drones and related vehicles are working examples of command guidance.

Homing—A missile which is guided by an internal mechanism that can "see" the target then make commands is a "homing" missile. There are several kinds of homing: active, semi-active, and passive. If the target is illuminated by equipment within the missile, it is active. If the intermediate radar is used to illuminate the target, the system is semi-active. If the target illuminates itself, the system is passive, i.e., heat seekers.

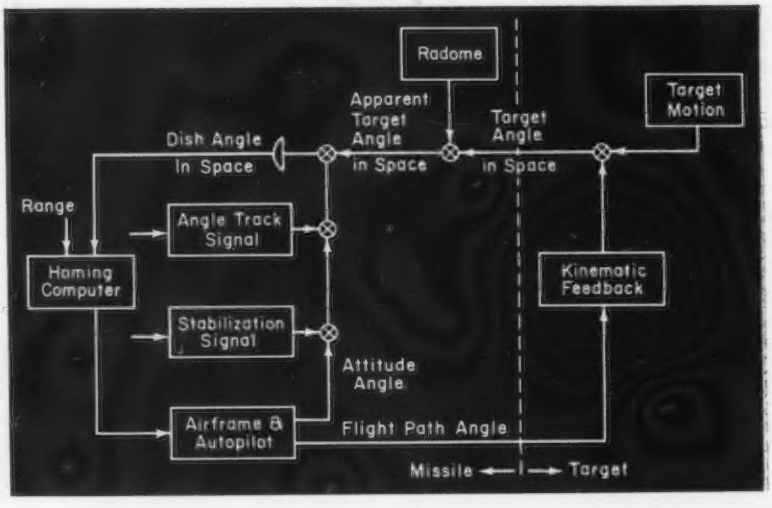
Another way to classify homing systems is by the frequency of the signal that the guidance homes on, or seeks. From the low to high frequency spectrum then, there would be sound seekers on the low side. This kind of system is used in torpedoes and has many limitations. Electromagnetic radiations would be next, and are the most popular media for homing guidance. Radio "jamming" can do an effective job of confusing this kind of system. Radar would be used in active and semi-active systems; it is not restricted to any great extent by weather, but can be jammed. Heat is used with passive seekers. This kind of system has had great success in Sidewinder and later Falcons. The new Redeye also uses heat seeking guidance. Light would be highest in the homing spectrum and is useful as a passive seeker. It is limited by weather.

Doppler homing is one of the latest innovations in active homing. It uses a phenomena of frequency change that occurs when the target moves relative to the "tracking" antenna.

Inertial—The system of guidance whose primary instruments respond to Earth's gravitational field and Newton's laws of motion, is called inertial guidance. This system is entirely independent of information obtained from transmitters outside the missile. Position, time, speed, and course are known before launch. Then, the missile proceeds along this planned course. As in "dead reckoning" navigation, the longer the mission, the greater the uncertainty that the planned course will be followed.

The basic principle of inertial guidance is simple. Missile acceleration is measured by accelerometers. These accelerations represent changes in direction and distance

HOMING



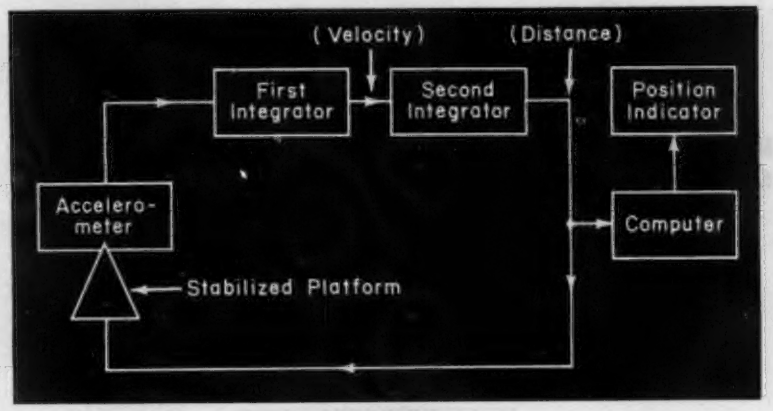
and are fed to a computer. The computer double-integrates the accelerations to obtain distances traveled in forward and sideward motion. These are compared to "stored" values and steering signals are generated to make the values obtained by integration agree with the "stored" values. Basic elements in all inertial systems are: the attitude reference, the accelerometer, the clock, the computer, and the memory.

The attitude reference is precisely oriented at the beginning of the flight. It remembers which way is North, and "which way is up." This is done by gyros mounted on a stable platform, one gyro for each of three spatial coordinates. The computer and clock are needed for the double integration process. The memory unit stores the planned course to destination.

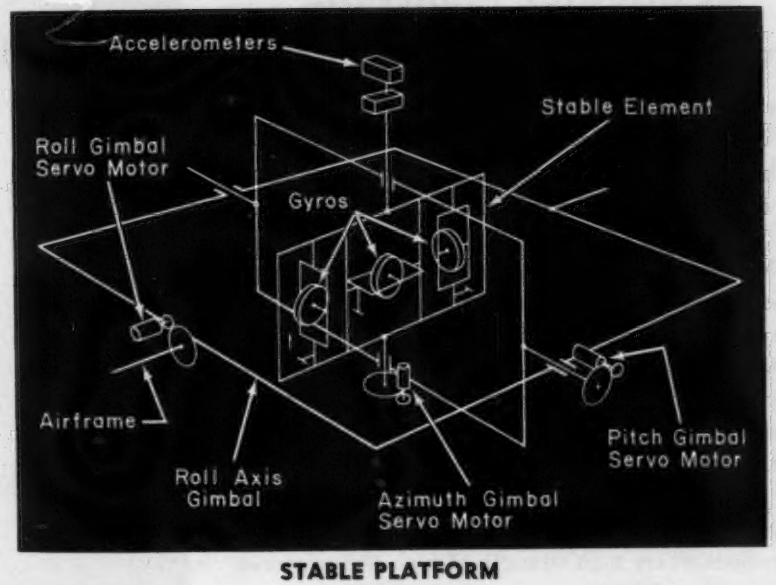
Heart of the system is the set of ultra-precision gyros and accelerometers. The HIG (Hermetric Integrating Gyro) has made inertial systems feasible. HIG gyros have an operating range of only a few degrees, and to prevent cross coupling, error input angles must be kept small. The gyros are, therefore, mounted on a platform which is servo driven to maintain gyro output near a null. The platform thus remains fixed relative to inertial space. This is the so-called "stable platform." The first ICBM inertial navigation systems are just coming into reality.

Radio-Inertial—Till now, all ICBM flights called inertial, have actually been radio-inertial. This is a command-type guidance, made up of: (1) a radar tracking unit on the ground, one or more transponders in the missile, and proper links to the guidance station; (2) a computer that accepts signals and generates steering signals; (3) a command link; (4) a simple inertial system for providing "current" data for correcting the missile, or providing limited guidance in case the radio link should fail.

Terrestrial Reference—A system of map matching is used in one guidance scheme. A comparison of maps previously obtained by reconaissance is matched electronically to actual course and target area. The system is not easily jammed.

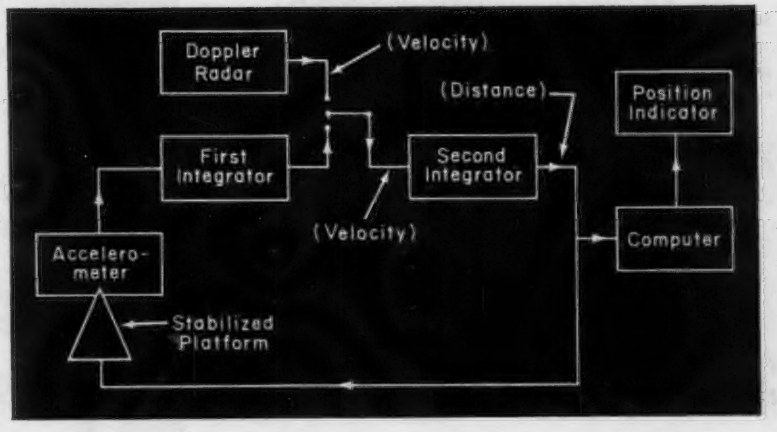


INERTIAL



STABLE PLATFORM

RADIO-INERTIAL



◆

zero plus

. . . and Carlson special stainless steels withstand the extremes of another launching

When this missile "lifts off," Carlson special stainless steel plates help launch it into space. These plates are the high strength, precipitation-hardening grades. And there are sound reasons why these grades are used.

First, with Armco 17-4PH, 17-7PH and PH15-7 Mo* it is easier to attain the high physical properties and resistance to elevated temperatures required in space flight engineering. Simplified low temperature heat treatment will develop a Rockwell hardness of C40 to C50. Tensile strengths, so vital in missile components, range from 180,000 to 220,000 psi in plates.

Second, only Carlson produces these Armco grades in the heavier plate thicknesses. For applications where high strength at high temperatures and ease of fabrication are important, get plates in these grades from Carlson. We will be glad to work with you on specific applications.

*17-4PH, 17-7PH and PH15-7 Mo are trade marks of Armco Steel Corporation

G. O. CARLSON Inc.

Stainless Steels Exclusively

148 Marshalton Road
THORNDALE, PENNSYLVANIA
District Sales Offices in Principal Cities

PLATES • PLATE PRODUCTS • HEADS • RINGS • CIRCLES
FLANGES • FORGINGS • BARS and SHEETS (No. 1 Finish)

Photo of Atlas missile courtesy
CONVAIR ASTRONAUTICS,
A Division of General Dynamics Corp.

400° above to 110° below in minutes*

TEST CHAMBER TEMPERATURE

...WITH PURECO CO_2 "BLAST COLD"

CO_2 is Best... For Test

The Pureco CO_2 *Blast Cold* process is a simple, efficient low cost method of refrigeration for low temperature test chambers. Direct injection of Pureco carbon dioxide liquid drops temperatures to required levels in a fraction of the time required by mechanical units. Cooling is produced by vaporizing a jet of liquified CO_2 directly into the chamber.

Extremely close tolerances maintained.

Temperatures are automatically controllable within limits closer than government testing standards require. Pureco CO_2 *Blast Cold* starts immediately at maximum rate the instant valves cycle on—stops the instant CO_2 flow is cut off.

Low capital expense... low operating cost.

No heavy investment required for equipment... installation is simple and space saving. Equipment is trouble-free. There is virtually no possibility of mechanical failure.

Direct or Indirect Cooling.

CO_2 liquid may be injected or DRY-ICE placed directly in a chamber—used to cool a circulating air stream or a non-freezing solution for indirect cooling.

Have a trial Blast Cold demonstration.

Pureco would like to demonstrate *Blast Cold* to you at *your* plant under your working conditions, with no obligation on your part. Pureco's Technical Sales Service will provide any assistance you need to help solve your low temperature testing problems.

**Actual Pureco Test*

Visit our Booth #66-67 at
Institute of Environmental Sciences Show

PURECO CO_2

PURE CARBONIC

Pure Carbonic Company, A Division of Air Reduction Company, Incorporated
Nation-Wide Pureco CO_2 Service-Distributing Stations in Principal Cities
General Offices: 150 East 42nd Street, New York 17, N.Y.

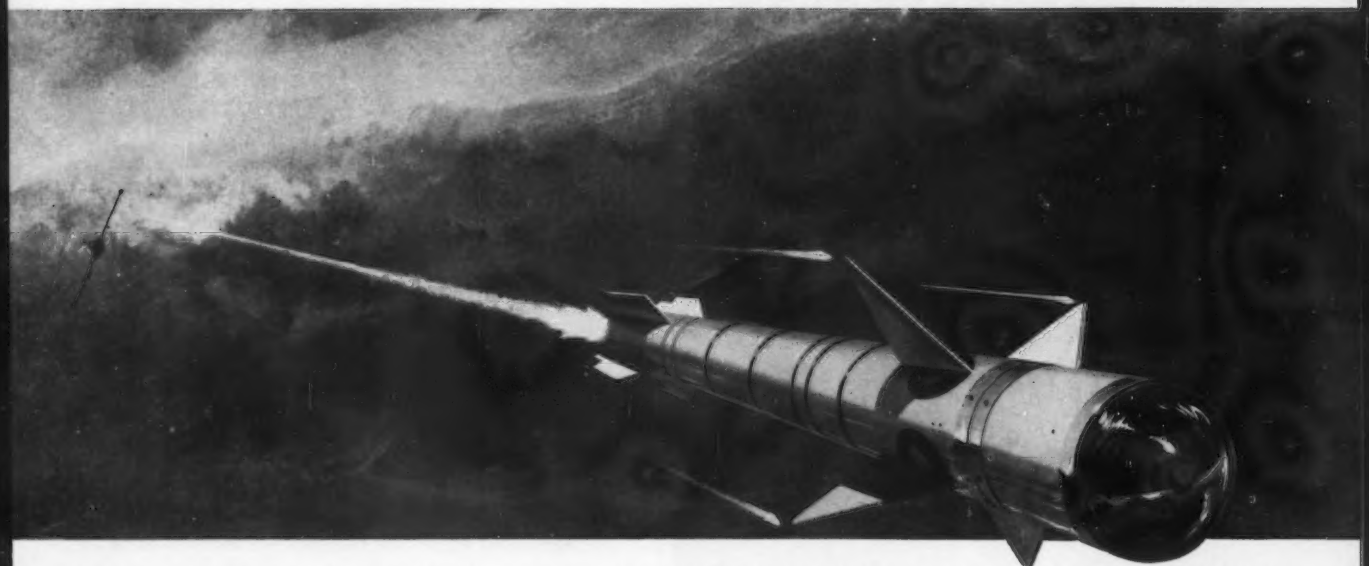
AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT

PHILCO HAS THE CAPACITY...

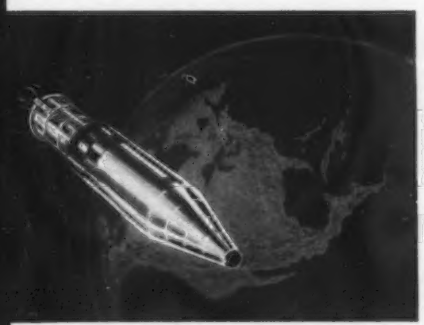
the people, the capabilities, the facilities, to conduct the research and development, engineering, design and manufacturing

FOR MANY AND VARIED ELECTRONIC PRODUCTS AND SYSTEMS

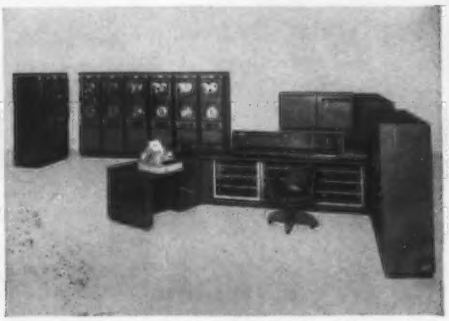
including weapons systems, satellites, space instrumentation, guided missiles, global communications, radar, data links, fire control systems, underwater ordnance, air traffic control, data processing systems and closed-circuit TV.



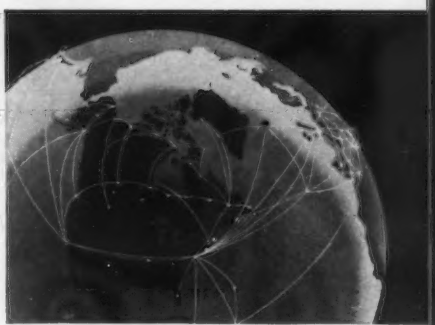
DEADLY SIDEWINDER . . . Developed by Philco in conjunction with the Navy, engineered and produced by Philco, this renowned air-to-air guided missile is an outstanding example of the results of close coordination between Philco and the Military on weapons systems development.



SATELLITE COMMAND AND TRACKING. . . As sub-contractor for Discoverer's entire communications system, Philco designed and developed the vast complexity of ground-space communications, commanding, tracking, data gathering and processing system.



DATA PROCESSING . . . Recognized as the world's first and finest all-transistor, large-scale data processing system, the Philco-2000 truly represents a new horizon in the state of the art. The Philco-2000 is the *only asynchronous computer* commercially available. This means faster computing and freedom from obsolescence.



WORLD'S LARGEST COMMUNICATIONS SYSTEM . . . Under contract with the U. S. Air Force, Philco will modernize and expand Aircom, for phase "Quick Fix". This vast global network will utilize advanced techniques in point-to-point and air-to-ground communications.

Philco Corporation/Government and Industrial Group/Philadelphia 44, Pennsylvania

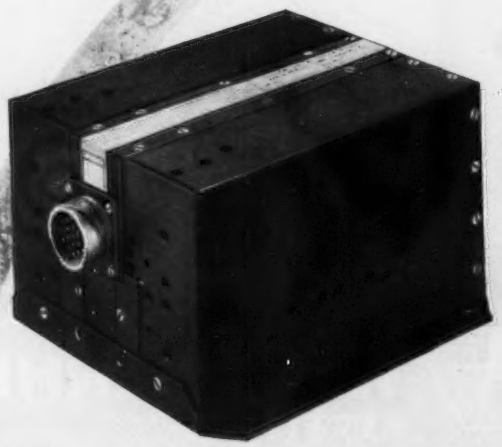
Communications and Weapons Systems Division • Computer Division • Sierra Electronic Division • Western Development Laboratories

PHILCO®

Famous for Quality the World Over

VĀP-AIR

windshield controller



- infinite range of temperatures from 0 to full heat
- simplest, lightest in weight
- immediate response to changes in speed
- proven components

Maintains control over a 25° F. range, ±2½°. Combines thermal control, power contactor and transformer in one small, lightweight control. Eliminates adjustment of power taps and periodic windshield matching, thermal shock, all moving electrical contacts in control box and contactors.

SPECIFICATIONS:

Normal operating voltage	200v. single phase, 400 cycles
Ambient operating temperature	−65° to 160° F
Operating power	Dependent on load
Output efficiency	85 to 90%
Dimensions	7" x 5½" x 5"
Weight	9 lbs.

VAP-AIR—SPECIALISTS IN AIRCRAFT TEMPERATURE CONTROLS FOR NEARLY 20 YEARS

Entire systems and a complete line of sensors, electronic controls and precise voltage regulation, electropneumatic and electromechanical valves, advanced in-line valves and regulators, electric power controllers and heat exchange equipment—for aircraft, missiles and ground support.

for complete technical information and applications write:

VAP-AIR AERONAUTICAL PRODUCTS DIVISION
VAPOR HEATING CORPORATION, DEPT. 50-C
80 East Jackson Blvd., Chicago 4, Illinois

NEW YORK • ST. PAUL • DENVER • WASHINGTON • PHILADELPHIA • ATLANTA
SAN FRANCISCO • HOUSTON • RICHMOND • LOS ANGELES • ST. LOUIS

Please send information on the Vap-Air Proportioning Power Windshield Controller.

NAME_____

FIRM_____

ADDRESS_____

CITY, ZONE, STATE_____

BRAID-LOK PERMANENTLY ATTACHED
* "super-gem" DETACHABLE, RE-USABLE HOSE ASSEMBLIES OF TEFLON **
HOSE, END FITTINGS and ASSEMBLIES
MS ER FLARELESS TUBE FITTINGS
CLUSTER and SWIVEL FITTINGS
VALVES and BENT TUBE ASSEMBLIES
HYDRAULIC and PNEUMATIC CYLINDERS
QUICK-DISCONNECT, SELF-SEALING COUPLINGS
FORGINGS (cored and solid)
* "super-gem": Aeroquip Trademark
** TEFLON: Dupont Trademark
FOR AIRCRAFT and MISSILE HYDRAULICS and PNEUMATICS
Rely on
WEATHERHEAD
FITTINGS and COMPONENTS
Designed and engineered for lightweight, simplified configuration and dependability.
For quality and reliability where it counts, "specify WEATHERHEAD"
Write us today regarding your special requirements.
Thrusting Skyward
... beyond tomorrow
THE WEATHERHEAD COMPANY
Products for the Aviation & Missile Industry
SPECIAL PRODUCTS DIVISION: Cleveland 8, Ohio
WESTERN DIVISION: Glendale, California
EASTERN AIRCRAFT PRODUCTS DIV. Cleveland 8, O.
Export: WEATHCO, Cleveland
In Canada: St. Thomas, Ontario

AIRCRAFT & MISSILES 1960

POWERPLANTS

The "big push" that will assure U. S. a place in the space race of this decade will be provided by engines already in design or production. Description of these engines and a list of the manufacturers are included in this section.

Propulsion data is also tabulated for the fuel and oxidizer combinations that seem logical for rockets. The data has been assembled with the cooperation of the National Aeronautics and Space Administration. It represents some of the most current, valid information on propellants.

Specifications on aircraft engines as well as gas turbines used in ground support are also tabulated.

Rocket Powerplant Characteristics

Specifications, applications, and manufacturers of leading engines

COMPANY	Engine Designation	Purpose	Used With	Thrust (lb)	Fuel	Oxidizer	Specific Impulse (lb-sec/lb)	Weight (lb)	Length (in.)	Diam. (in.)	Operating Press. (psi)	Exit Area (ft^2)	Ae/At	THRUST CHAMBER Material	THRUST CHAMBER Design
Aerojet-General Corp. 6352 N. Irwindale Ave., Azusa, Calif.	2.5 KS-1800 (Ceramic-Lined)	Booster	Aerobee-100, -150	18,600 @ 2.5 sec.	(Solid Propellant)		178	340	78		1340	0.494			Single Wall
		Sustainer	Aerobee-100	2,600 @ 40 sec.	JP-4	IRFNA	200	260	230.9	15	330	0.205			
		"	Aerobee-150	4,100 @ 50.9 sec.	65-35 AN-FA	IRFNA	198	269	294	15	324	0.297			
	LR87	1st Stage	Titan	300,000	RP-1	Liquid Oxygen									
	LR91	2nd Stage	Titan	70,000	"	"									
		Booster & Sustainer	Eagle		(Solid Propellant)										
		Sustainer	Genie		"	"									
		Dual Sustainer	Hawk		"	"									
		Booster	"		"	"									
		2nd & 3rd Stg.	Minuteman		"	"									
		1st & 2nd Stg.	Polaris		"	"									
	Aerojet Jr. & Sr.	1st Stage	Scout		"	"									
		Dual Sustainer	Tartar		"	"									
		Booster	Bomarc		"	"									
		Sustainer	Bullpup		"	"									
		"	GAR-9		"	"									
		"	Sparrow		"	"									
		"	Terrier		"	"									
		1st & 2nd Stg.	ALB-7		"	"									
Allegheny Ballistics Lab. Cumberland, Md.	ABL-248	3rd Stage	Thor-Able		(Solid Propellant)										
		Boost. & Sustainer	Terrier		"	"									
Bell Aircraft Corp. Buffalo 5, N. Y.	8001	Sustainer	Thor, Atlas	150,000	JP-4	RFNA									Double Wall
	8048	"	" "	150,000	UDMH	RFNA									" "
	8081	"	" "												" "
	8096	"	" "												" "
	Reaction Controls	Steering	Mercury, X-15, Centaur	1 to 200	(H_2O_2 mono-propellant)										
	8011	Sustainer			High-Energy	High-Energy									Double Wall
	Hustler	2nd Stage	Thor-Hustler												
General Electric Co., Flight Propulsion Lab. Dept. Cincinnati 15, Ohio	X-405	1st Stg. Vanguard		27,850, 140 sec.	Kerosene	Liquid Oxygen		500	80	40					Double Wall
	Plug Nozzle	Main Stage													
	X-405-HR	Sustainer			UDMH	N_2O_4									
	X-405-H	Vega			Kerosene	Liquid Oxygen									Tube Bundle
B. F. Goodrich Aviation Products Rocket Motor Development Rialto, Calif.	.83KS3200(Loki I)	Booster	sleds, probes	3180, .83 sec.	Composite Solid	Perchlorate	212	17.9	66	3	1500	1.416		Aluminum	Extruded Tube
	1.9KS2100	"	" "	2110, 1.84 sec.	" "	"	234	22.52	66	3	1400	0.983		"	" "
	1.9KS2000	"	" "	1989, 1.87 sec.	" "	"	219	23.13	66.4	3	1321	0.983		"	" "
Grand Central Rocket Co. Redlands, Calif.	Mercury	escape rocket	Mercury	60,000	(Solid propellant	GCR-229A)	85.2	645	70.5	15.5	2000	0.14	12:1	4130	Single Wall
	Lance	Booster	sleds, probes	50,000	(" "	GCR-221)	151	1682	185	15.1	950	0.182	6.37:1	"	" "
	Javelin	"	" "	24,400	(" "	GCR-229A)	165	349.5	100.3	9	1408	0.079	5.37:1	"	" "
	Viper 1B	"	" "	5400	(" "	GCR-201-C)	161	188.5	106.9	6.50	777	0.033	6.4:1	"	" "
	Viper 1C	"	" "	5400	(" "	")	152.5	199.1	"	6.54	"	"	"	"	" "
	Viper 11B	"	" "	8000	(" "	GCR-200K)	157.3	190.6	106.9	6.50	894	0.045	4.72:1	"	" "
	Viper 11C	"	" "	8000	(" "	")	149.2	201.2	"	6.54	"	"	"	"	" "
		Sustainer	Nike-Zeus		(" "	)									
Hercules Powder Co. 900 Market St., Wilmington 99, Del.		3rd Stage	Minuteman		(Solid Propellant)										
		Sustainer	Honest John		"	"									
		"	Sidewinder		"	"									
Hughes Tool Co.-Aircraft Div. Culver City, Calif.	XLR107-HT-1	Booster	sleds	3750-10,000	(60/40 Ethylnitrate Propylnitrate)		200	127	98.38	11.12	700-1100	0.024	5.96:1	4130	Single Wall
	"	"	"	"	"	"	"	"	"	"	"	0.041	3.56:1	"	" "
M. W. Kellogg Co. Sub. Pullman Inc. Danforth Ave., Jersey City, N. J.		Booster & Sustainer	Terrier		(Solid Propellant)										

COMPANY	Engine Designation	Purpose	Used With	Thrust (lb)	Fuel	Oxidizer	Specific Impulse (lb-sec/lb)	Weight (lb)	Length (in.)	Diam. (in.)	Operating Press. (psi)	Exit Area (ft^2)	Ae/At	THRUST CHAMBER Material	THRUST CHAMBER Design
Pratt & Whitney Aircraft Florida R. & D. Center West Palm Beach, Fla.	XLR115-P-1	Upper Stage	Centaur, Saturn	15,000	Liquid Hydrogen	Liquid Oxygen								AISI 347	Tube Bundle
Rocketdyne Div. N. American Aviation, Inc. 6633 Canoga Ave. Canoga Park, Calif.	XLR89NA-5	Booster	Atlas	360,000	RP-1	Liquid Oxygen									Tube Bundle
	XLR105NA-5	Sustainer	"		"	"									"
	XLR70NA-9	Booster	Thor	150,000	"	"									"
	Jupiter S-3D	Booster	Jupiter	150,000	"	"									"
	H-1	Booster (8)	Saturn	1,500,000	"	"									"
	E-1	R&D		400,000	"	"									"
	F-1	Booster	Nova	1,500,000	"	"									"
	Redstone A-7	Booster	Redstone	75,000	Alcohol	Liquid Oxygen	238	240	201	28.44	560	0.44	12	T-1 Steel	Double Wall
	AR-Series	Aircraft	FJ-4	3000-6000	JP-4005	H_2O_2	186	3500	264	38	1300		8.8:1	"	Single Wall
	XM-34	Booster	F100-D	130,000, 4 sec.	Solid	NH_4NO_3		6459						4130 Steel	Double Wall
	Megaboom	"	Sled	100,000, 10 sec.	"	"								"	"
		Vernier	Atlas, Thor		RP-1	Liquid Oxygen									
		1st Stage	Thor-Hustler		"	"									
Ryan Aeronautical Co. 2701 Harbor Drive, San Diego 12, Calif.		Sustainer	Corporal	20,000	Aniline	RFNA		125	60	30	750			1025 Steel	Double Wall
Thiokol Chemical Corp. Bristol, Pa.		Sustainer	Nike-Hercules		(Solid Propellant)										
		Booster	"	450,000	"	"									
		"	Nike-Zeus		"	"									
		Spin Rockets	Honest John		"	"									
		Sustainer	Lacrosse		"	"									
		Booster	Little Joe		"	"									
		Sustainer	Sergeant		"	"									
		Booster	Bomarc		"	"									
		Sustainer	Falcon		"	"									
	Falcon Engine	Retro-Rocket	Thor, Atlas-Able		Liquid Ammonia	Liquid Oxygen	255		72	36	600			347 Stainless	Tube Bundle
	XLR89	Powerplant	X-10	50,000	Amine-Base Liq.	RFNA								6061-T4 Aluminum	Double Wall
	Guardian I	Sustainer	Sparrow III		"	"								"	"
	Guardian II	"	Bullpup		"	"								"	"
Liquid-Prepack Engines		"	Corvus		(Solid Propellant)										
		3 Stages	Minuteman		"	"									
		2 Stages	Pershing		"	"									
		2nd Stage	Polaris		"	"									
		Sustainer	Subroc		"	"									

THIS IS THE CORRECT EASY WAY

Don't chain your engineers to time-consuming routine on repetitive blueprint items . . . free them for more creative work and save countless hours of expensive drafting time with STANPAT.

STANPAT prints these items on tri-acetate sheets that are easily transferred to your tracings. No special equipment required . . . reproductions come out sharp and clear . . . and STANPAT is incredibly inexpensive.

19 YEARS OF SERVICE TO INDUSTRY

STANPAT COMPANY
Whitestone 57, N. Y., U. S. A.
Phone: FLushing 9-1693-1611

☐ Please quote on enclosed samples.
☐ Kindly send me STANPAT literature and samples. Dept. 163

Name_____
Title_____
Company_____
Address_____

Circle 39 on Inquiry Card

1960 .... U.S. AIRCRAFT ENGINES

RECIPROCATING TYPE

ENGINE MAKE AND MODEL	A. T. C. Number	GENERAL DATA											RATINGS								Propeller Drive Ratio (to —1)	Weight (Lb.)		Carburetor		Ignition System—Make	Starting		Installation Dimensions (Overall—Ins.)			Height above Engine Bed	Diameter Mounting Ring or Distance Between Bearers
		Arrangement	Cooling Medium	Number of Cylinders Bore and Stroke (In.)	Total Piston Displacement (Cu. In.)	Compression Ratio (to —1)	B.M.E.P. at Maximum Hp. (Lb. per Sq. In.)	Blower Ratio	Cylinder Material	No. of Valves per Cylinder: Intake	No. of Valves per Cylinder: Exhaust	Valve Arrangement	Maximum (Except Take-off): Horsepower	Maximum (Except Take-off): R. P. M.	Maximum (Except Take-off): At Sea Level or Altitude (Ft.)	Take-off: Horsepower	Take-off: R. P. M.	Cruising: Horsepower	Cruising: R. P. M.	Octane Rating of Fuel Required		Engine Dry—Without Hub or Starter	Per Maximum Hp. (Except Take-off)	Number Used and Make	Type		Make	Method	Length	Height or O. D.	Width		
Continental A-65-8F	205	Hor	Air	4-3⅞x3⅝	171.0	6.30	131	N	SA	1	1	IH	65	2300	SL	65	2300	.....	.....	80/87	D	170	2.62	1-MS	FL	Scin	N	.....	28.34	27.83	31.56	.....	(1)
A-65-12F	205	Hor	Air	4-3⅞x3⅝	171.0	6.30	131	N	SA	1	1	IH	65	2300	SL	65	2300	.....	.....	80/87	D	174	2.68	1-MS	FL	Scin	DR	EM	31.26	28.72	31.56	.....	(1)
C-85-8F	233	Hor	Air	4-4⅛x3⅝	188.0	6.30	139	N	SA	1	1	IH	85	2575	SL	85	2575	.....	.....	80/87	D	176	2.07	1-MS	FL	Scin	N	.....	28.34	27.83	31.56	.....	(1)
C-85-12F	233	Hor	Air	4-4⅛x3⅝	188.0	6.30	139	N	SA	1	1	IH	85	2575	SL	85	2575	.....	.....	80/87	D	180	2.12	1-MS	FL	Scin	DR	EM	31.26	28.72	31.56	.....	(1)
C-90-8F	252	Hor	Air	4-4⅛x3⅝	200.9	7.00	143	N	SA	1	1	IH	90	2475	SL	90	2475	.....	.....	80/87	D	184	2.04	1-MS	FL	Scin	N	.....	28.34	27.83	31.56	.....	(1)
C-90-12F	252	Hor	Air	4-4⅛x3⅝	200.9	7.00	143	N	SA	1	1	IH	90	2475	SL	90	2475	.....	.....	80/87	D	188	2.09	1-MS	FL	Scin	DR	EM	31.26	28.72	31.56	.....	(1)
E-185-9	246	Hor	Air	6-5x4	471.0	7.00	135	N	SA	1	1	IH	185	2300	SL	205	2600	.....	.....	80/87	D	352	1.90	1-Str	PI	Scin	DR	EM	46.66	22.30	33.41	.....	(2)
E-225-4	267	Hor	Air	6-5x4	471.0	7.00	146	N	SA	1	1	IH	225	2600	SL	225	2600	.....	.....	80/87	D	355	1.58	1-Ben	PI	Scin	Ecl	EM	46.66	22.30	33.41	.....	(2)
O-200-A	252	Hor	Air	4-4⅛x3⅞	200.9	7.00	143	N	SA	1	1	IH	100	2750	SL	100	2750	.....	.....	80/87	D	190	1.90	1-MS	FL	Scin	DR	EM	28.53	23.18	31.56	.....	(1)
O-300-A	253	Hor	Air	6-4⅛x3⅞	301.0	7.00	141	N	SA	1	1	IH	145	2700	SL	145	2700	.....	.....	80/87	D	268	1.85	1-MS	FL	Scin	DR	EM	35.38	23.25	31.56	.....	(2)
GO-300-A	298	Hor	Air	6-4⅛x3⅞	301.0	7.30	144	N	SA	1	1	IH	175	3200	SL	175	3200	.....	.....	80/87	.7500	314	1.79	1-MS	FL	Scin	DR	EM	39.12	27.05	31.56	.....	(2)
O-470-13A	269	Hor	Air	6-5x4	471.0	7.00	146	N	SA	1	1	IH	225	2600	SL	225	2600	.....	.....	80/87	D	415	1.84	1-Ben	PI	Scin	Ecl	EM	40.96	26.44	33.62	.....	.....
O-470-15	269	Hor	Air	6-5x4	471.0	7.00	140	N	SA	1	1	IH	190	2300	SL	213	2600	.....	.....	80/87	D	405	2.13	1-Str	FL	Scin	DR	EM	44.75	26.61	33.41	.....	(2)
O-470-H[11]	273	Hor	Air	6-5x4	471.0	8.00	156	N	SA	1	1	IH	240	2600	SL	240	2600	.....	.....	91/96	D	471	1.96	1-Ben	PI	Scin	DR	EM	67.65	.....	33.58	.....	(2)
O-470-J	273	Hor	Air	6-5x4	471.0	7.00	165	N	SA	1	1	IH	225	2550	SL	225	2550	.....	.....	80/87	D	378	1.68	1-MS	FL	Scin	DR	EM	36.03	27.75	33.58	.....	(2)
O-470-K & L	273	Hor	Air	6-5x4	471.0	7.00	149	N	SA	1	1	IH	230	2600	SL	230	2600	.....	.....	80/87	D	404	1.76	1-MS	FL	Scin	DR	EM	36.03	27.75	33.58	.....	(2)
O-470-M	273	Hor	Air	6-5x4	471.0	8.00	156	N	SA	1	1	IH	240	2600	SL	240	2600	.....	.....	91/96	D	410	1.71	1-MS	FL	Scin	DR	EM	43.31	19.62	33.56	.....	(2)
O-470-2	281	Hor	Air	6-5x4	471.0	7.00	162	10.36	SA	1	1	IH	250	2600	10000	265	2600	.....	.....	100/130	D	484	1.94	1-Ben	PI	Scin	DR	EM	37.73	30.77	33.62	.....	(2)
10-470-C	273	Hor	Air	6-5x4	471.0	8.00	162	N	SA	1	1	IH	250	2600	SL	250	2600	.....	.....	91/96	D	432	1.73	1-CMC	Inj	Scin	DR	EM	37.56	26.25	33.58	.....	(2)
10-470-D	3E1	Hor	Air	6-5x4	471.0	8.60	167	N	SA	1	1	IH	260	2625	SL	260	2625	.....	.....	100/130	D	430	1.65	1-CMC	Inj	Scin	DR	EM	43.31	19.75	33.56	.....	(2)
FSO-526-A[3]	292	Hor	Air[4]	6-5½x4¼	526.0	6.00	129	10.04	SA	1	1	IH	270	3000	7900	270	3200	.....	.....	91/96	D	553	2.05	1-Ben	PI	Scin	DR	EM	50.33	28.54	34.64	.....	(2)
GSO-526-A	303	Hor	Air	6-5½x4¼	526.0	6.00	151	12.88	SA	1	1	IH	300	3000	14500	340	3100	.....	.....	91/96	.6880	556	1.85	1-Ben	PI	Scin	DR	EM	52.28	23.96	34.68	.....	(2)
Franklin 4A4-100-B3	239	Hor	Air	4-4½x3½	225.0	7.00	136	N	AC	1	1	IH	100	2600	SL	.....	.....	75	2370	80	D	214	2.14	1-MS	FL	Eis	AL	EM	30.68	20.59	30.81	12.03	.....
6A4-150-B3	238	Hor	Air	6-4½x3½	335.0	7.00	136	N	AC	1	1	IH	150	2600	SL	.....	.....	113	2370	80	D	291	1.94	1-MS	FL	Eis	DR	EM	37.37	22.59	30.81	13.03	.....
6A4-165-B3	238	Hor	Air	6-4½x3½	335.0	7.00	139	N	AC	1	1	IH	165	2800	SL	.....	.....	124	2550	80	D	307	1.86	1-MS	PI	Scin	DR	EM	37.37	25.31	30.81	13.03	.....
6V4-200-C32, C33	244	Ver	Air	6-4½x3½	335.0	8.50	152	N	AC	1	1	IH	200	3100	SL	.....	.....	.....	.....	91	D	306	1.53	1-BM	P-FL	Scin	DR	EM	26.81	36.00	30.81	.....	.....
6AG4-190-B13	238	Hor	Air	6-4½x3½	335.0	7.60	141	N	AC	1	1	IH	190	3100	SL	.....	.....	.....	.....	80	.6320	324	1.11	1-BM	P-FL	Scin	DR	EM	40.59	26.12	30.81	.....	.....
6V-335-A, B	244	Ver	Air	6-4½x3½	335.0	8.50	157	N	AC	1	1	IH	210	3100	SL	.....	.....	.....	.....	91	.....	306	1.46	1-MS	FL	Scin	DR	EM	26.81	36.00	30.81	.....	.....
6A-335-A	244	Hor	Air	6-4½x3½	335.0	8.50	157	N	AC	1	1	IH	210	3100	SL	.....	.....	.....	.....	91	.....	307	1.46	1-MS	FL	Scin	DR	EM	40.59	26.12	30.81	.....	.....
6VS-335[12]	1E2	Ver	Air	6-4½x3½	335.0	7.00	172	.....	AC	1	1	IH	225	3100	SL	.....	.....	.....	.....	100/130	.....	365	1.62	1-MS	FL	Scin	.....	EM	39.75	38.00	31.56	.....	.....
Herrmann X-375	293	Bar	Liq	12-3¼x3¾	373.0	8.00	112	.....	Alu	1	1	OH	175	1800	.....	200	1900	175	1800	80/87	D	322[13]	1.84	S-Str	FL	S-A	DR	EM	50.50	18.00	21.50	12.00	10.00
Lycoming O-235-C1	223	Hor	Air	4-4⅜x3⅞	233.3	6.75	141	N	SA	1	1	IH	108	2600	SL	115	2800	81	2360	80	D	207	1.92	1-MS	FL	Scin	DR	EM	29.56	22.53	32.00	.....	.....
O-290-D2B[3]	229	Hor	Air	4-4⅞x3⅞	289.0	7.00	137	N	SA	1	1	IH	135	2600	SL	140	2800	100	2350	80/87	D	236	1.75	1-MS	FL	Scin	DR	EM	29.56	22.81	32.24	.....	(1)
O-320-A2B[3]	274	Hor	Air	4-5⅛x3⅞	319.8	7.00	138	N	SA	1	1	IH	150	2700	SL	150	2700	112	2450	80/87	D	244	1.62	1-MS	FL	Scin	DR	EM	29.56	23.12	32.24	.....	(1)
O-320-B3B	279	Hor	Air	4-5⅛x3⅞	319.8	8.50	147	N	SA	1	1	IH	160	2700	SL	160	2700	120	2450	91/96	D	250	1.55	1-MS	FL	Scin	DR	EM	29.56	23.12	32.24	.....	(1)
O-340-A1A	277	Hor	Air	4-5⅛x3⅝	340.4	8.40	146	N	SA	1	1	IH	170	2700	SL	170	2700	127	2450	91/96	D	250	1.47	1-MS	FL	Scin	DR	EM	29.56	24.68	32.55	.....	(1)
O-360-A1A	286	Hor	Air	4-5⅛x4⅛	361.0	8.50	148	N	SA	1	1	IH	180	2700	SL	180	2700	135	2450	91/96	D	257	1.41	1-BM	P-FL	Scin	DR	EM	29.56	24.72	33.37	.....	(1)
O-360-C2B[3]	286	Hor	Air	4-5⅛x4⅛	361.0	8.50	146	N	SA	1	1	IH	180	2700	SL	180	2700	135	2450	91/96	D	261	1.45	1-Ben	PI	Scin	DR	EM	30.67	19.81	33.37	.....	(1)
VO-360-A1A[5]	1E1	Ver	Air	4-5⅛x4⅛	361.0	8.50	136	N	SA	1	1	IH	180	2900	SL	180	2900	145	2900	91/96	D	270	1.50	1-MS	FL	Scin	DR	EM	29.79	21.92	33.37	.....	(1)
VO-435-A1E[5]	279	Ver	Air	6-4⅞x3⅞	434.0	7.30	143	N	NA	1	1	IH	250	3200	SL	260	3400	200	3200	80/87	D	392	1.56	1-MS	FL-P	Scin	Opt	EH	34.73	24.13	33.58	.....	.....
GO-435-C2B2-6	228	Hor	Air	6-4⅞x3⅞	434.0	7.30	146	N	NA	1	1	IH	240	3000	SL	260	3400	180	2750	80/87	.6420	430	1.79	1-BM	P-FL	Scin	Opt	EM	38.64	28.02	33.12	.....	(2)
GO-480-B1A6	275	Hor	Air	6-5⅛x3⅞	479.7	7.30	143	N	NA	1	1	IH	260	3000	SL	270	3400	195	2750	80/87	.6420	432	1.68	1-Str	PI	Scin	Opt	EM	38.64	28.02	33.12	.....	(2)
GO-480-B1D	275	Hor	Air	6-5⅛x3⅞	479.7	7.30	143	N	NA	1	1	IH	260	3000	SL	270	3400	195	2750	80/87	.6420	432	1.66	1-Str	PI	Scin	Opt	EM	38.64	28.02	33.12	.....	(2)
GO-480-G1A6	275	Hor	Air	6-5⅛x3⅞	479.7	8.70	143	N	SA	1	1	IH	280	3000	SL	295	3400	210	2750	100/130	.6420	439	1.57	1-Ben	PI	Scin	Opt	EM	38.64	28.02	33.12	.....	(2)
GO-480-G1B6	275	Hor	Air	6-5⅛x3⅞	479.7	8.70	154	N	SA	1	1	IH	280	3000	SL	295	3400	210	2750	100/130	.6420	464	1.64	1-Str	PI	Scin	Opt	EM	40.04	27.46	33.12	.....	(2)
GO-480-G2D6	275	Hor	Air	6-5⅛x3⅞	479.7	8.70	152	N	NA	1	1	IH	285	3100	SL	295	3400	210	2750	100/130	.6420	442	1.55	1-Str	PI	Scin	Opt	EM	40.59	28.02	33.12	.....	(2)
GSO-480-B1A6	284	Hor	Air	6-5⅛x3⅞	479.7	7.30	154	11.27	SA	1	1	IH	320	3200	8000	340	3400	240	2750	100/130	.6420	498	1.56	1-Str	PI	Scin	Opt	EM	49.31	33.08	33.12	.....	(2)
GSO-480-B1B6	284	Hor	Air	6-5⅛x3⅞	479.7	7.30	154	11.27	SA	1	1	IH	320	3200	8000	340	3400	240	2750	100/130	.6420	500	1.56	1-Str	PI	Scin	Opt	EM	46.22	33.26	33.12	.....	(2)
GSO-480-B1C6	284	Hor	Air	6-5⅛x3⅞	479.7	7.30	154	11.27	SA	1	1	IH	320	3200	8000	340	3400	240	2750	100/130	.6420	497	1.55	1-Str	PI	Scin	Opt	EM	52.18	22.56	33.12	.....	(2)
GSO-480-B2D6	284	Hor	Air	6-5⅛x3⅞	479.7	7.30	154	11.27	SA	1	1	IH	320	3200	8000	340	3400	240	2750	100/130	.6420	498	1.56	1-Str	PI	Scin	.....	EM	47.06	22.56	33.12	.....	(2)
IGSO-480-A1A6	284	Hor	Air	6-5⅛x3⅞	479.7	7.30	165	11.27	SA	1	1	IH	320	3200	11000	340	3400	240	2750	100/130	.6420	496	1.55	1-Sim	Inj	Scin	Opt	EM	47.56	23.29	33.12	.....	(2)
O-540-A1B5	295	Hor	Air	6-5¼x4⅜	541.5	8.50	139	N	SA	1	1	IH	260	2700	SL	265	2800	195	2450	91/96	D	368	1.42	1-MS	FL	Scin	DR	EM	37.22	25.81	33.37	.....	(1)
O-540-A1C5	295	Hor	Air	6-5¼x4⅜	541.5	8.50	157	N	SA	1	1	IH	250	2575	SL	250	2575	190	2350	91/96	D	368	1.47	1-MS	FL	Scin	DR	EM	37.22	25.81	33.37	.....	(1)
O-540-F1B5[3]	295	Hor	Air	6-5¼x4⅜	541.5	8.50	136	N	SA	1	1	IH	235	2800	4000	260	2800	175	2600	91/96	D	369	1.57	1-MS	FL	Scin	.....	EM	38.42	24.56	33.37	.....	(2)

| | | |

GAS TURBINE ENGINES 1960

Line Number	MAKE AND MODEL	ENGINE TYPE: Turbo-jet or Prop.	ENGINE TYPE: Single or Coupled	PERFORMANCE: TAKE-OFF: Thrust (Lb.)	TAKE-OFF: Prop. Shaft (Hp.)	TAKE-OFF: RPM	TAKE-OFF: Fuel Consumption	NORMAL: Thrust (Lb.)	NORMAL: Prop. Shaft (Hp.)	NORMAL: RPM	NORMAL: Fuel Consumption	MAX. CRUISING: Thrust (Lb.)	MAX. CRUISING: Prop. Shaft (Hp.)	MAX. CRUISING: RPM	MAX. CRUISING: Fuel Consumption	Propeller Gearing Type	COMPRESSOR: Type	COMPRESSOR: No. of Stages	COMPRESSOR: Pressure Comp. Ratio	COMPRESSOR: Blade Roots	TURBINE: No. of Stages	TURBINE: Blade Roots
	AIRCRAFT PROPULSION TYPE																					
	UNITED STATES																					
1	Allison J-33-A-41	TJ	S	5200	N	12150	1.17[1]		N			4275	N	11500	1.14[1]	N	Ce	Du	4.35	In		
2	T-56-A-1	TP	S	726	3460	13820	.54[2]	702	3094	13820	.55[2]	702	3094	13820	.55[2]	P	A	14	9.25	Do	4	FT
3	501-D-13	TP	S	726	3460	13820	.54[2]	702	3094	13820	.56[2]	145	1820	13820	.46[2]	P	A	14	9.46	Do	4	FT
4	T-56-A-7	TP	S	740	3755	13820	.53[2]	718	3443	13820	.54[2]	718	3443	13820	.54[2]	P	A	14	9.64	Do	4	FT
5	T-56-A-8	TP	S	740	3755	13820	.53[2]	718	3443	13820	.54[2]	718	3443	13820	.54[2]	P	A	14	9.64	Do	4	FT
6	T-56-A-9	TP	S	726	3460	13820	.54[2]	702	3094	13820	.55[2]	702	3094	13820	.55[2]	P	A	14	9.25	Do	4	FT
7	T-56-A-10W	TP	S	750	4200[11]	13820		718	3443	13820	.54[2]	718	3443	13820	.54[2]	P	A	14	9.64	Do	4	FT
8	T-63-A-1	TP	S	Ne	250	2057	.70	Ne	212	2057	.73	Ne	212	2057	.73	P	AC	7	6.40	In	4	In
9	T-63-A-3	TP	S	Ne	250	6022	.70	Ne	212	6022	.73	Ne	212	6022	.73	N	AC	7	6.40	In	4	In
10	T-61-A-5	TP	S	995	6102	10400	.50[2]	853	5294	9900	.52[2]	750	4770	9450	.54[2]	SGP	A	15	11.60	Do	5	FT
11	Boeing 500-10	TJ		248	N		1.12[1]	235	N		1.12[1]		N			N	Ce	1	4.25	In	1	W
12	502-10-C	TP	S		270	3200	1.00		240	3200	1.05					P	Ce	1	4.25	In	2	W
13	502-2	TP	S		430	6200	.72		375	6000	.76					P	Ce	1	6.50	In	2	W
14	502-10-MA	TP			300	3400	.92		270	3300	.95					P	Ce	1	4.40	In		
15	502-4	TP	S		475	2390	.71		400	2250	.74					P	Ce	1	6.50	In		
16	502-10-W	TP			325	2900	.89		270	2700	.94					P	Ce	1		In		
17	502-10-S	TP			360	3400			360	3400	.90					P	Ce	1	4.77	In		
18	Continental XT-51-T-3 (Art II)	TP	S		425	34800	.98[2]									SpG	Ce	1	3.95	In	2	In
19	320 (Palas)	TJ		350	N	34000	1.18[1]	290	N	31500	1.10		N			N	Ce	1	3.90	In	1	In
20	324 (Arbizon)	TJ		550	N	34500	1.12[1]	435	N	32500	1.08[1]		N			N	Ce	2	5.00	In	2	In
21	J-69-T-25	TJ		1025	N	21730	1.14[1]	880	N	20700	1.12[1]		N			N	Ce	1	3.80			FT
22	J-69-T-29	TJ		1700	N	22000	1.10[1]	1375	N	20790	1.09[1]		N			N	CA	2	5.50			FT
23	354-12	TJ		1150	N		1.23[1]	920	N		1.20[1]					N	Ce	1				
24	General Electric J-79	TJ		15000	N	7684		15000	N			15000	N			N	A	17	12.00	T	3	FT
25	J-93-3	TJ			N				N				N			N						
26	CJ-805-3	TJ		11200	N	7684	.81[1]	9500	N		.74[1]	8850	N		.73[1]	N	A	17	13.00	T	3	FT
27	T-64-4	TP	S		2570	1150	.52[2]		2230		.53[2]					P	A	14	12.60	Do		
28	J-85-5	TJ		3850	N				N				N			N		8				
29	J-85-7	TJ		2450	N				N				N			N		8				
30	CF-700-1	TuF		4000	N		.69[1]	3770	N		.69[1]	3254	N		.68[1]	N	A	8				
31	CJ-805-23	TuF		16100	N		.54[1]	13700	N		.51[1]	13300	N		.51[1]	N	A	17	13.00	T		
32	Lycoming LTC1F-1	TP		113	960	1700	.65	100	825	1700	.67					P	AC	6	6.00	Do	2	FB
33	LTC4A-1	TP		190	1600	1320	.64	168	1325	1230	.68					P	AC	8	6.30	Do	3	FT
34	Pratt & Whitney JT3C-2	TJ	S	13750	N		.95[1]	9500	N		.77[1]	8550	N		.77[1]	N	A	16	13.00	FT		
35	JT3C-6	TJ	S	13500	N		.92[1]	9500	N		.77[1]	8100	N		.77[1]	N	A	16	13.00	FT		
36	JT3C-7	TJ	S	12000	N		.79[1]	10000	N		.77[1]	8500	N		.77[1]	N	A	16	13.00	FT		
37	JT3C-21	TJ	S	16900	N		2.30[1]	9150	N		.82[1]	8250	N		.82[1]	N	A	16	13.00	FT		
38	JT3D-1	TuF	S	17000	N		.52[1]	14500	N		.51[1]	12500	N		.50[1]	N	A	15		FT		
39	PT2G-6	TP	S	1375	6950	1000	.55[1]	1250	5150	977	.63[1]	1125	4120	955	.67[1]	P	A	13	6.70	FT		
40	PT2G-7	TP	S	1375	6950	1000	.55[1]	1250	5150	977	.63[1]	1150	4380	960	.66[1]	P	A	13	6.70	FT		
41	JT3C-12	TJ	S	13000	N		.82[1]	10000	N		.77[1]	8500	N		.77[1]	N	A	16	13.00	FT		
42	JT3D-2	TuF	S	17000	N		.59[1]	14500	N		.56[1]	13050	N		.55[1]	N	A	15		FT		
43	JT3D-3	TuF	S	18000	N		.54[1]	16400	N		.52[1]	14800	N		.51[1]	N	A	15		FT		
44	JT3D-4	TuF	S	18000	N			15000	N				N			N	A	15		FT		
45	JT4A-3	TJ	S	15800	N		.78[1]	12500	N		.74[1]	11450	N		.74[1]	N	A	15	12.00	FT		
46	JT4A-5	TJ	S	15800	N		.78[1]	12500	N		.74[1]	11450	N		.74[1]	N	A	15	12.00	FT		
47	JT4A-9	TJ	S	16800	N		.81[1]	13500	N		.75[1]	11850	N		.74[1]	N	A	15	12.00	FT		
48	JT4A-10	TJ	S	16800	N		.81[1]	13500	N		.75[1]	11850	N		.74[1]	N	A	15	12.00	FT		
49	JT4A-11	TJ	S	17500	N		.84[1]	14900	N		.77[1]	13800	N		.75[1]	N	A	15	12.00	FT		
50	JT4A-12	TJ	S	17500	N		.84[1]	14900	N		.77[1]	13800	N		.75[1]	N	A	15	12.00	FT		
51	JT4A-28	TJ	S	24500	N		2.15[1]	14300	N		.79[1]	12900	N		.77[1]	N	A	15	12.00	FT		
52	JT4A-29	TJ	S	26500	N		2.20[1]	14300	N		.79[1]	12900	N		.77[1]	N	A	15	12.00	FT		
53	JT12A-5	TJ	S	3000	N		.96[1]	2570	N		.91[1]	2310	N		.90[1]	N	A	9		FT		
54	JT12A-7	TJ	S	3300	N		1.00[1]	2650	N		.92[1]	2385	N		.90[1]	N	A	9		FT		
55	JT12A-21	TJ	S	4025	N		2.42[1]	2350	N		.93[1]	2110	N		.92[1]	N	A	9		FT		
56	Solar YT-62-S-2	TP							55	4045	1.30[2]					SpG	Ce	1	3.30			
57	Westinghouse J-34-WE-36	TJ		3400	N								N			N	A			Ba		
58	J-34-WE-46	TJ		3400	N				N				N			N	A			Ba		
59	J-54-WE-2	TJ		6000	N				N				N			N	A					
60	XJ-81	TJ		1740	N				N				N			N	A					
61	Wright J-65-W-5	TJ	S	7220	N	8300	.92[1]	6400	N	8000			N			N	A	13		FT	2	FT
62	J-65-W-7	TJ	S	7800	N	8300	.91[1]	6870	N	8000	.88[1]		N			N	A	13		FT		
63	J-65-W-16	TJ	S	7700	N	8300	.92[1]	6780	N	8030	.90[1]		N			N	A	13		FT		
64	J-65-W-18	TJ	S	10500	N		2.20[1]	6470	N	8030	.92[1]		N			N	A	13		FT		
	FRANCE																					
65	Dassault R-7	TJ		3110	N	11800	1.75[1]	2760	N	11200	1.04[1]		N			N	A	7			1	
66	Hispano-Suiza HS-Nene 105	TJ		5100	N	12500	1.00[1]	4620	N	12200		4050	N	11800		N	Ce		4.40	FT	1	
67	HS-Tay 250	TJ		6280	N	11000	1.06[1]		N				N			N	Ce		4.25	FT	1	
68	HS-Verdon 350	TJ		7720	N	11100	1.10[1]	6834	N	10800		6172	N	10500		N	Ce		4.95	FT	1	
69	HS-R-800	TJ		2645	N				N				N			N	A			FT	1	
70	HS-R-804	TJ		3306	N	12000	1.08[1]	3000	N		1.07[1]	2645	N	11250		N	A	7		FT	1	
71	S.N.E.C.M.A. Atar E-5	TJ		8180	N	8400	1.05[1]	6570	N	8050	1.01[1]	5740	N	7850	1.00[1]	N	A	8	4.80		1	
72	Atar G-2, G-3	TJ		9730	N	8400	2.05[1]	7500	N	8400	1.11[1]	5070	N	7850	1.08[1]	N	A	8	4.80		1	
73	Atar 8	TJ		9730	N	8400	.98[1]	7400	N	8150	.94[1]	6850	N	8000	.93[1]	N	A	9	5.20		2	
74	Atar 9	TJ		13250	N	8400	2.07[1]	9400	N	8400	1.01[1]	6520	N	8000	.97[1]	N	A	9	5.20		2	
75	Atar 9-C, 9-D	TJ		13250	N	8400	2.07[1]	11900	N	8400	1.69[1]	7500	N	8150	.97[1]	N	A	9	5.70			

1960 .... GAS TURBINE ENGINES

COMBUSTION CHAMBERS				FUEL SYSTEM						IGNITION SYSTEM		LUBRICATION		MAKE OF COMPONENT PARTS					OVERALL DIMENSIONS			DRY WEIGHT		
																			Length (In.)					
Arrangement	No. Used	Material	Air Intake	No. of Pumps	No. of Emergency Pumps	Fuel Controls	Afterburning	Recommended Octane Rating of Fuel	No. Fuel Nozzles per Combustion Chamber	No. of Ignitors	Type of Ignitor	Sump Capacity (Pts.)	Max. Oil Consumption (Pts./Hr.)	Starter	Generator	Governor	Vacuum Pump	Fuel Pumps	With Extension Pipe	Without Extension Pipe	Max. Diameter (In.)	With Component Parts (Lb.)	Without Component Parts (Lb.)	Line Number
AIRCRAFT PROPULSION TYPE																								
UNITED STATES																								
Cy	.....	.....	.....	1	N	M	N	JP-4	1	1	Sp	24.0	2.0	Gov	Gov	.....	.....	Pes	156.2	.....	48.9	1796	.....	1
Cn	8	SS	TF	2	1	HM	N	JP-4	1	2	Sp	Dry	3.6	Gov	Gov	Gov	Gov	Pes	.....	145.2	40.3	1675	.....	2
Cn	8	SS	TF	2	1	HM	N	AK	1	2	Sp	Dry	3.4	FA	FA	FP	.....	Pes	.....	145.2	42.5	1758	.....	3
Cn	8	SS	TF	2	1	HM	N	JP-4	1	2	Sp	Dry	2.8	Gov	Gov	Gov	Gov	Pes	.....	146.2	42.0	1848	.....	4
Cn	8	SS	TF	2	1	HM	N	JP-5	1	2	Sp	Dry	2.8	Gov	Gov	Gov	Gov	Pes	.....	146.2	42.0	1852	.....	5
Cn	8	SS	TF	2	1	HM	N	JP-4	1	2	Sp	Dry	3.6	Gov	Gov	Gov	Gov	Pes	.....	146.2	42.0	1679	.....	6
Cn	8	SS	TF	2	1	HM	N	JP-4,JP-5	1	2	Sp	Dry	2.8	Gov	Gov	Gov	Gov	Pes	.....	146.2	42.5	1845	.....	7
Cn	1	SS	RF	2	1	HM	N	JP-4	1	1	Sp	Dry	1.2	Gov	Gov	Gov	.....	.....	.....	40.9	18.9	110	.....	8
Cn	1	SS	RF	2	1	HM	N	JP-4	1	1	Sp	Dry	1.2	Gov	Gov	N	.....	.....	.....	38.2	18.9	95	.....	9
Cn	7	SS	TF	2	1	HM	N	JP-4	1	2	Sp	Dry	3.2	Gov	Gov	Gov	Gov	Pes	.....	142.0	45.0	2240	.....	10
Cy	2	SS	TF	1	.....	M	N	G,De,K,JP-4	1	2	SG	12.0	Ne	Var	Var	Var	.....	Var	34.0	24.0	.....	210	210	11
Cy	2	SS	TF	1	.....	M	N	G,De,K,JP-4	1	2	SG	12.0	Ne	Var	Var	Var	.....	Var	41.5	.....	24.3	330	330	12
Cy	2	SS	RF	1	.....	M	N	G,De,K,JP-4	.....	2	SG	12.0	Ne	Var	Var	Var	.....	Var	42.0	42.0	24.0	380	380	13
Cy	2	SS	TF	1	.....	M	N	G,De,K,JP-4	1	2	SG	12.0	Ne	Var	Var	Var	.....	Var	41.5	41.5	24.3	325	325	14
Cy	2	SS	RF	1	.....	M	N	G,De,K,JP-4	.....	2	SG	12.0	Ne	Var	Var	Var	.....	Var	68.8	68.8	25.5	325	325	15
Cy	2	SS[6]	TF	.....	.....	M	N	G,De,K,JP-4	1	2	SG	12.0	Ne	Var	Var	Var	.....	Var	44.8	.....	24.3	325	325	16
.....	2	SS	TF	1	.....	.....	N	G,De,K,JP-4	.....	2	SG	12.0	Ne	Var	Var	Var	.....	Var	41.5	41.5	24.3	290	290	17
An	1	NS	.....	1	.....	M	N	G,K,JP-4	.....	2	Sp	.....	.5	.....	.....	.....	.....	.....	.....	44.3	23.2	250	236	18
An	1	NS	.....	1	.....	M	N	G,K,JP-4	.....	2	Sp	.....	.5	.....	.....	.....	.....	.....	41.6	.....	16.0	.....	137	19
An	1	.....	.....	.....	.....	M	N	.....	.....	2	Sp	.....	.83	.....	.....	.....	.....	.....	.....	48.6	15.9	214	.....	20
An	1	.....	.....	1	N	HM	N	JP-4	1	2	Sp	.....	.53	FA	FA	Ben	FA	Ben	Var	49.9	22.3	364	.....	21
An	1	.....	.....	1	N	HP	N	.....	1	2	Sp	.....	1.03	.....	.....	.....	.....	.....	Var	44.8	22.3	335	.....	22
An	1	.....	.....	1	N	.....	N	JP-4	1	2	Sp	.....	1.03	FA	FA	.....	.....	.....	.....	.....	22.3	275	.....	23
Cn	10	SA	DF	.....	.....	HM	Y	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	204.0	.....	36.0	3200	.....	24
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
Cn	10	SA	DF	1	N	HM	N	K,JP-4,JP-5	1	2	Sp	33.0	1.0	AR	Own	Ww	.....	Pes	188.9	109.6	31.6	2800	3190	26
An	1	.....	DF	1	.....	HM	N	JP-5	12	2	Sp	25.0	1.83	AI	Own	N	N	Par	113.0	.....	36.0	1079	.....	27
.....	1	.....	.....	.....	.....	.....	Y	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	104.0	.....	20.2	525	.....	28
.....	1	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.3	.....	17.7	325	.....	29
.....	1	.....	.....	.....	.....	HM	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70.0	.....	33.0	585	.....	30
Cn	10	SA	DF	1	N	HM	N	K,JP-4,JP-5	1	2	Sp	33.0	1.03	AR	Own	Ww	.....	Pes	144.0	.....	53.0	3825	.....	31
An	1	SS	RF	1	(4)	HM	N	JP-4	11	2	Sp	.....	1.1	.....	.....	.....	.....	CE	.....	58.4	23.0	530	.....	32
An	1	SS	RF	1	(4)	HM	N	JP-4	14	2	Sp	.....	1.6	.....	.....	.....	.....	HS	.....	58.8	24.2	695	.....	33
Cn	8	.....	DF	1	.....	HM	N	JP-4	6	2	Sp	.....	2.0	.....	.....	.....	.....	Cc	.....	167.3	38.6	.....	3840	34
Cn	8	.....	DF	1	.....	HM	N	JP-4, JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	Cc	.....	.....	38.9	.....	4234	35
Cn	8	.....	DF	1	.....	HM	N	JP-4, JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	Cc	.....	.....	38.9	.....	3495	36
Cn	8	.....	DF	1	1	HM	Y	JP-4	6	2	Sp	.....	2.7	.....	.....	.....	.....	PT	.....	250.8	39.6	.....	4750	37
Cn	8	.....	DF	1	1	HM	Y	JP-4, JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	.....	53.0	.....	4025	38
Cn	8	.....	DF	1	1	HM	N	JP-4	1	2	Sp	.....	5.0	.....	.....	.....	.....	Pes	.....	155.1	34.1	.....	2870	39
Cn	8	.....	DF	1	1	HM	N	JP-4	1	2	Sp	.....	5.0	.....	.....	.....	.....	.....	155.1	.....	34.1	.....	2870	40
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	.....	38.9	.....	3495	41
Cn	8	.....	DF	1	.....	HM	N	JP-4	6	2	Sp	.....	.....	.....	.....	.....	.....	.....	.....	.....	53.0	.....	3900	42
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	.....	53.0	.....	4130	43
Cn	8	.....	DF	1	.....	HM	N	JP-4	6	2	Sp	.....	.....	.....	.....	.....	.....	.....	.....	.....	53.0	.....	3950	44
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	144.2	43.0	.....	5020	45
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	144.2	43.0	.....	4815	46
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	144.2	43.0	.....	5050	47
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	144.2	43.0	.....	4845	48
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	144.2	43.0	.....	5100	49
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	6	2	Sp	.....	3.2	.....	.....	.....	.....	.....	.....	144.2	43.0	.....	4895	50
Cn	8	.....	DF	1	1	HM	Y	JP-4	6	2	Sp	.....	3.6	.....	.....	.....	.....	.....	.....	237.6	43.0	.....	5875	51
Cn	8	.....	DF	1	1	HM	Y	JP-4	6	2	Sp	.....	3.6	.....	.....	.....	.....	.....	.....	259.3	43.0	.....	5960	52
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	1	2	Sp	.....	1.2	.....	.....	.....	.....	.....	.....	.....	21.9	.....	436	53
Cn	8	.....	DF	1	.....	HM	N	JP-4,JP-5	1	2	Sp	.....	2.0	.....	.....	.....	.....	.....	.....	.....	21.9	.....	465	54
Cn	8	.....	DF	1	.....	HM	Y	.....	.....	2	Sp	.....	1.2	.....	.....	.....	.....	.....	.....	.....	21.9	.....	651	55
An	1	SS	DF	1	N	.....	N	.....	6	1	Sp	6.0	.1	N	N	Own	N	El	.....	24.8	12.5	52	.....	56
An	.....	.....	DF	.....	.....	.....	.....	JP-3	.....	2	Sp	.....	.73	.....	.....	.....	.....	.....	.....	112.0	27.0	1200	.....	57
An	.....	.....	DF	.....	.....	.....	.....	JP-4,JP-5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	112.0	27.0	1242	.....	58
An	.....	.....	DF	.....	.....	.....	.....	JP-4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	123.0	28.0	.....	.....	59
An	.....	.....	DF	.....	.....	.....	.....	JP-4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	69.9	15.8	304	.....	60
An	1	SS	DF	2	N	.....	.....	.....	36	2	.....	.....	.....	Gov	Gov	Th	.....	Th	138.8	.....	37.5	2696	2500	61
An	1	SS	DF	2	N	M	N	.....	36	2	Sp	.....	.....	Gov	Gov	.....	.....	Th	.....	114.8	37.5	2795	.....	62
An	1	SS	DF	2	N	M	N	.....	36	2	Sp	.....	.....	Gov	Gov	.....	.....	Th	.....	121.9	37.5	2742	.....	63
An	1	SS	DF	3	N	M	Y	.....	36	2	Sp	.....	.....	Gov	Gov	.....	.....	Cc	181.1	.....	37.5	3485	.....	64
FRANCE																								
An	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	93.5	29.5	750	.....	65
Cy	9	.....	.....	2	.....	H	N	.....	1	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	96.0	49.5	1606	.....	66
Cy	9	.....	.....	2	.....	H	N	.....	1	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	100.0	50.0	1973	.....	67
Cy	9	.....	DF	2	.....	H	N	.....	1	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	104.0	50.0	2072	.....	68
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	69
An	1	.....	.....	1	.....	M	Y	.....	.....	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	78.8	27.7	678	.....	70
An	20	.....	DF	1	.....	H	N	.....	.....	2	SG	17.5	1.9	Own	.....	BS	.....	BS	198.0	92.5	38.8	1945	.....	71
An	20	.....	DF	1	1	H	Y	.....	.....	2	SG	17.5	1.9	Own	.....	BS	.....	BS	253.0	.....	39.4	2720	.....	72
An	20	.....	.....	1	.....	H	N	.....	.....	2	SG	11.5	1.3	Own	.....	BS	.....	BS	180.0	112.0	33.4	2310	.....	73
An	20	.....	DF	1	1	H	Y	.....	.....	2	SG	11.5	1.3	Own	.....	BS	.....	BS	263.0	.....	33.4	2940	.....	74
An	.....	.....	DF	1	1	H	Y	.....	.....	2	SG	11.5	1.3	Own	.....	BS	.....	BS	264.0	.....	40.0	2900	.....	75

GAS TURBINE

Line Number	MAKE AND MODEL	ENGINE TYPE		PERFORMANCE												Propeller Gearing Type	COMPRESSOR				TURBINE	
				TAKE-OFF				NORMAL				MAX. CRUISING										
		Turbo-jet or Prop.	Single or Coupled	Thrust (Lb.)	Prop. Shaft (Hp.)	RPM	Fuel Consumption	Thrust (Lb.)	Prop. Shaft (Hp.)	RPM	Fuel Consumption	Thrust (Lb.)	Prop. Shaft (Hp.)	RPM	Fuel Consumption		Type	No. of Stages	Pressure Comp. Ratio	Blade Roots	No. of Stages	Blade Roots
	AIRCRAFT PROPULSION TYPE—*concluded*																					
	FRANCE—*Continued*																					
1	Turbomeca.....Marbore VI	TJ	.....	1058	N	21500	1.12[1]	926	N	.....	1.17[1]	.....	N	.....	.....	N	Ce	1	3.84	.....	1	.....
2	.....Bastan II	TP	.....	146	740	33500	.70[2]	146	592	33500	.75[2]	.....	.....	.....	.....	.....	CA	2	5.45	.....	3	.....
3	.....Astazou	TP	.....	85	420	43000	.67[2]	85	370	43000	.76[2]	.....	.....	.....	.....	.....	CA	2	5.81	.....	3	.....
4	.....Gourdon II	TJ	.....	1411	N	21500	1.00[1]	1191	N	.....	.98[1]	1140	N	.....	.99[1]	N	CA	2	5.00	.....	1	.....
5	.....Palas	TJ	.....	352	N	34000	1.17[1]	285	N	.....	1.13[1]	.....	N	.....	.....	N	Ce	1	3.95	.....	1	.....
6	.....Marbore II	TJ	.....	880	N	22600	1.08[1]	710	N	.....	1.09[1]	120	N	.....	.....	N	Ce	1	3.85	.....	1	.....
7	.....Gabizo	TJ	.....	2420	N	17500	1.05[1]	2000	N	.....	1.00[1]	.....	N	.....	.....	N	Ce	1	5.20	.....	1	.....
	GREAT BRITAIN																					
8	Blackburn.....Palas 600	TJ	S	390	N	35000	1.20[1]	340	N	33000	1.14[1]	365	N	34000	1.17[1]	N	Ce	1	4.12	In	1	In
9	Bristol-Siddeley.....Viper 8	TJ	.....	1750	N	.....	1.07[1]	.....	N	.....	.....	547	N	.....	1.28[1]	N	A	7	4.05	Cl	1	FT
10	.....Viper 9	TJ	.....	1900	N	.....	1.12[1]	.....	N	.....	.....	580	N	.....	1.33[1]	N	A	7	4.25	Cl	1	FT
11	.....Viper 11	TJ	.....	2500	N	.....	1.04[1]	.....	N	.....	.....	750	N	.....	1.25[1]	N	A	7	4.37	Pn	1	FT
12	.....Viper 12	TJ	.....	2700	N	.....	1.08[1]	.....	N	.....	.....	820	N	.....	1.30[1]	N	A	7	4.47	Pn	1	FT
13	.....Orpheus Mk. 701	TJ	.....	4700	N	.....	1.06[1]	.....	N	.....	.....	1670	N	.....	1.33[1]	N	A	7	4.39	FT	1	FT
14	.....Orpheus Mk. 803	TJ	.....	5000	N	.....	1.08[1]	.....	N	.....	.....	1680	N	.....	1.34[1]	N	A	7	4.38	FT	1	FT
15	.....Orpheus Mk. 100	TJ	.....	4230	N	.....	.96[1]	.....	N	.....	.....	1380	N	.....	1.24[1]	N	A	7	4.39	FT	1	FT
16	.....Orpheus 12	TJ	.....	8170	N	.....	1.82[1]	.....	N	.....	.....	2280	N	.....	1.25[1]	N	A	.....	.....	.....	.....	.....
17	....Sapphire Mk. 100 Series	TJ	.....	8200	N	.....	.87[1]	.....	N	.....	.....	2280	N	.....	1.05[1]	N	A	13	7.49	Fp	2	FT
18	.....Sapphire Mk. 200	TJ	.....	11000	N	.....	.88[1]	.....	N	.....	.....	3160	N	.....	1.08[1]	N	A	13	7.49	Fp	2	FT
19	....Sapphire Mk. 205 (Sa7R)	TJ	.....	12230	N	.....	1.38[1]	.....	N	.....	.....	.....	N	.....	.....	N	A	13	7.49	Fp	2	FT
20	.....Olympus Mk. 104	TJ	.....	13000	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
21	.....Olympus Mk. 201	TJ	.....	17000	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
22	.....Olympus	TJ	.....	33000	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
23	.....BE-58	TuF	.....	14500	N	.....	.57[1]	.....	N	.....	.....	3750	N	.....	.80[1]	N	A	.....	.....	.....	.....	.....
24	....Double Mamba ASMD-8	TP	C	730	3600	.....	.66[2]	.....	.....	.....	.....	275	2100	.....	.68[2]	P	A	11	5.80	Fp	3	FT
25	.....Proteus 765	TP	.....	1260	3910	.....	.60[2]	.....	.....	.....	.....	380	2197	.....	.48[2]	P	CA	13	7.20	FT	4	FT
26	de Havilland..Gyron Jr. DGJ-1	TJ	.....	7000	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	7	.....	.....	.....	.....
27	.....Gyron Jr. DGJ-10	TJ	.....	10000	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
28	.....Goblin 35	TJ	S	3500	N	10750	1.19[1]	2320	N	9500	1.16[1]	3000	N	10250	1.16[1]	N	Ce	1	3.87	In	1	FT
29	.....Ghost Mk. 105	TJ	S	5300	N	.....	1.19[1]	4480	N	.....	1.13[1]	.....	N	.....	.....	N	Ce	1	4.70	FT	.....	.....
30	.....Gnome P-1000	TP	.....	144	1000	20000	.67[2]	130	900	19000	.70[2]	120	800	17000	.73[2]	He	A	10	8.30	FT	.....	.....
31	Napier.....Eland N. El. 3	TP	S	500	2805	12500	.67[2]	420	2180	12000	.71[2]	355	1710	11500	.76[2]	P	A	10[5]	7.00[5]	FT	3	FT
32	.....Eland N. El. 6	TP	S	700	3230	12500	.61[7]	625	2670	12000	.63[7]	590	2420	11750	.65[7]	P	A	10	7.00	FT	.....	.....
33	.....Eland N. El. 7	TP	.....	650	3250	12500	.61[7]	625	2900	12500	.63[7]	550	2600	12000	.63[7]	P	A	10[5]	7.00[5]	FT	.....	.....
34	.....Eland 504	TP	S	700	3230	12500	.61[7]	625	2670	12000	.63[7]	590	2420	11750	.65[7]	P	A	10	7.00	FT	.....	.....
35	.....Eland 508	TP	S	700	3230	12500	.61[7]	665	2930	12250	.62[7]	625	2670	12000	.63[7]	P	A	10	7.00	FT	.....	.....
36	.....Eland E. 211[8]	TP	S	555	3500	12500	.64[7]	515	2850	12500	.68[7]	505	2650	12500	.69[7]	RG	A	10	7.00	FT	.....	.....
37	.....Eland E. 229A[8]	TP	S	545	3230	12500	.62[7]	505	2670	12500	.65[7]	495	2460	12500	.67[7]	.....	A	10	7.00	FT	.....	.....
38	Rolls-Royce Avon RA24, RA24R	TJ	S	11250	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
39	.....Avon RA 28	TJ	S	10000	N	.....	.86[1]	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
40	.....Avon RA 29	TJ	S	10500	N	.....	.77[1]	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	In	2	FT
41	.....Dart RDa 10	TP	S	670	2660	15000	.64[2]	.....	.....	.....	.....	585	2100	14500	.66[2]	P	Ce	2	.....	In	3	FT
42	.....Dart RDa 11	TP	S	655	2100	15000	.67[2]	.....	.....	.....	.....	570	1820	14500	.70[2]	P	Ce	2	.....	In	.....	.....
43	.....Dart 21	TP	S	430	1950	15000	.61[2]	.....	.....	.....	.....	315	1575	14200	.66[2]	P	Ce	2	.....	In	.....	.....
44	.....Dart 506	TP	S	365	1400	14500	.73[2]	.....	.....	.....	.....	295	1120	13800	.87[2]	P	Ce	2	5.50	In	2	FT
45	.....Dart 510	TP	S	370	1600	14500	.69[2]	.....	.....	.....	.....	300	1365	14000	.79[2]	P	Ce	2	5.50	In	2	FT
46	.....Dart 511	TP	S	370	1600	14500	.70[2]	.....	.....	.....	.....	300	1460	14200	.77[2]	P	Ce	2	5.50	In	2	FT
47	.....Dart 520	TP	S	495	1700	15000	.70[2]	.....	.....	.....	.....	295	1720	14400	.71[2]	P	Ce	2	5.75	In	3	FT
48	.....Dart 525	TP	S	500	1800	15000	.68[2]	.....	.....	.....	.....	440	1650	14400	.70[2]	P	Ce	2	5.75	In	3	FT
49	.....Dart 526, 527, 528, 529	TP	S	505	1910	15000	.66[2]	.....	.....	.....	.....	445	1750	14400	.68[2]	P	Ce	2	5.60	In	3	FT
50	.....RB 108	TJ	S	2010	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	.....	.....	.....	.....	.....	.....
51	.....Tyne RTy 1	TP	S	1265	4795	15250	.49[2]	.....	.....	.....	.....	.....	.....	.....	.....	P	A	.....	13.00	.....	.....	.....
52	.....Tyne RTy 11	TP	S	1290	4885	15250	.47[2]	.....	.....	.....	.....	1080	4455	14100	.47[2]	P	A	.....	.....	.....	.....	.....
53	.....RB 141	TJ	S	14200	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
54	.....RB 145	TJ	S	2750	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....
55	.....Conway RCo 11	TJ	S	17250	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	.....	.....	.....	.....	.....	.....
56	.....Conway RCo 12	TJ	S	17500	N	9985	.75[1]	14625	N	.....	.71[1]	11600	N	.....	.70[1]	N	A	9	14.00	Pn	.....	.....
57	.....Conway RCo 15	TJ	S	18500	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	.....	.....	.....	.....	.....	.....
58	.....Avon RB 146	TJ	.....	13220	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	.....	.....	.....	.....	.....	.....
59	.....RB 163	TJ	.....	10100	N	.....	.....	.....	N	.....	.....	.....	N	.....	.....	N	A	.....	.....	.....	.....	.....

ABBREVIATIONS

1—Pound per hour per pound of thrust.
2—Pound per horsepower per hour.
3—Pound per hour.
4—Included in main pump.
5—Main compressor only; nine stage auxilliary compressor for helicopter rotor tip jets.
6—Main compressor only; auxilliary compressor, 4.50.
7—Pound per equivalent shaft horsepower per hour.
8—Gas turbine with rear drive and hydraulic clutch for helicopter application.
9—Air horsepower.
10—Main compressor only; four stage auxilliary compressor, 1.80.
11—Based on water/alcohol augmentation.
A—Axial.
Ac—Air compressor.
AC—Axial centrifugal.
AI—Air impingement.
AK—Aviation kerosene.
A-M—Aircraft auxilliary power unit or marine.
An—Annular.
AP—Auxilliary power unit.
AR—Air Research Co.
AS—Air supply.
Ba—Ball.
Ben—Bendix.
BS—Bronzavia-Snecma.
C—Coupled.
CA—Centrifugal and axial.
Ce—Ceco.
Ce—Centrifugal.
CE—Chandler-Evans Co.
Cl—Clamp.
Cn—Cannular.
Cy—Cylindrical.
DD—Direct drive.
De—Diesel fuel.
DF—Direct flow.
DI—Dependent upon installation.
Do—Dovetail.
Dow—Dowty.
Du—Dual entry.
Ecl—Eclipse.
EI—Eastern Industries.
FA—Furnished by airframe manufacturer.
FB—Fir tree and ball.
FD—Fir tree and dovetail.
Fp—Fir tree and pin.

ENGINES—*continued*

Arrangement	COMBUSTION CHAMBERS: No. Used	COMBUSTION CHAMBERS: Material	COMBUSTION CHAMBERS: Air Intake	FUEL SYSTEM: No. of Pumps	FUEL SYSTEM: No. of Emergency Pumps	FUEL SYSTEM: Fuel Controls	FUEL SYSTEM: Afterburning	FUEL SYSTEM: Recommended Octane Rating of Fuel	FUEL SYSTEM: No. Fuel Nozzles per Combustion Chamber	IGNITION SYSTEM: No. of Ignitors	IGNITION SYSTEM: Type of Ignitor	LUBRICATION: Sump Capacity (Pts.)	LUBRICATION: Max. Oil Consumption (Pts./Hr.)	MAKE OF COMPONENT PARTS: Starter	MAKE OF COMPONENT PARTS: Generator	MAKE OF COMPONENT PARTS: Governor	MAKE OF COMPONENT PARTS: Vacuum Pump	MAKE OF COMPONENT PARTS: Fuel Pumps	OVERALL DIMENSIONS: Length (In.) With Extension Pipe	OVERALL DIMENSIONS: Length (In.) Without Extension Pipe	OVERALL DIMENSIONS: Max. Diameter (In.)	DRY WEIGHT: With Component Parts (Lb.)	DRY WEIGHT: Without Component Parts (Lb.)	Line Number.
AIRCRAFT PROPULSION TYPE—*concluded*																								
FRANCE—*Continued*																								
An	.....	.....	.....	.....	.....	.....	.....	JP-1,JP-4	.....	2	To	.....	.....	.....	.....	.....	.....	.....	.....	55.2	22.0	337	.....	1
An	.....	.....	.....	.....	.....	.....	.....	JP-1	.....	2	To	.....	.....	.....	.....	.....	.....	.....	.....	60.0	21.4	772	.....	2
An	.....	.....	.....	.....	.....	.....	.....	JP-1	.....	2	To	.....	.....	.....	.....	.....	.....	.....	.....	70.8	17.9	408	.....	3
An	.....	.....	.....	.....	.....	.....	.....	JP-1	.....	2	To	.....	.....	.....	.....	.....	.....	.....	.....	74.2	26.1	375	.....	4
An	.....	.....	.....	.....	.....	.....	.....	JP-1	.....	2	To	.....	.....	.....	.....	.....	.....	.....	.....	47.0	16.0	158	.....	5
An	.....	.....	.....	.....	.....	.....	.....	JP-1,JP-4	.....	2	To	.....	.....	.....	.....	.....	.....	.....	.....	62.0	25.0	314	.....	6
An	.....	.....	.....	.....	.....	.....	.....	JP-1	.....	2	To	.....	.....	.....	.....	.....	.....	.....	.....	82.0	26.0	585	.....	7
GREAT BRITAIN																								
An	1	NS	DF	1	N	M	N	.....	RI	1	To	8.0	.1	Ple	Rot	Luc	N	Ple	43.8	30.0	18.0	.....	168	8
An	1	.....	.....	1	N	H	.....	.....	24	2	HE	.....	1.3	Rot	.....	Luc	N	Luc	.....	67.0	24.3	.....	510	9
An	1	.....	.....	1	N	H	.....	.....	24	2	HE	.....	1.3	Rot	.....	Luc	N	Luc	.....	67.0	24.3	.....	510	10
An	1	.....	.....	1	N	H	.....	.....	24	2	HE	.....	1.3	.....	.....	Luc	N	Luc	.....	64.0	24.6	.....	549	11
An	1	.....	.....	1	N	H	.....	.....	24	2	HE	.....	1.3	.....	.....	Luc	N	Luc	.....	64.0	24.6	.....	549	12
Cn	1	NS	.....	1	N	H	.....	.....	7	2	.....	12.0	2.0	Rot	Rot	Luc	N	Luc	.....	73.0	32.4	.....	790	13
Cn	1	NS	.....	1	N	H	.....	.....	7	2	.....	14.0	2.0	.....	.....	Luc	N	Luc	.....	75.5	32.4	.....	835	14
Cn	1	NS	.....	1	N	H	.....	.....	7	2	.....	.....	.....	.....	.....	.....	.....	Luc	.....	77.5	32.4	.....	900	15
.....	1	.....	.....	.....	N	.....	Y	.....	7	2	.....	.....	.....	.....	.....	.....	.....	Luc	.....	81.4	32.4	.....	1110	16
An	1	.....	.....	1	N	H	.....	.....	36	2	HE	.....	1.5	Rot	Rot	Dow	N	Dow	.....	109.8	37.4	.....	2670	17
An	1	.....	.....	1	N	H	.....	.....	24	2	HE	.....	1.5	.....	Rot	Dow	N	Dow	.....	125.2	37.8	.....	3110	18
An	1	.....	.....	1	N	H	Y	.....	24	2	HE	1.0	1.5	.....	Rot	Dow	N	Dow	.....	130.7	37.4	.....	3110	19
Cn	1	.....	.....	1	N	.....	.....	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	132.0	42.4	.....	.....	20
Cn	1	.....	.....	2	N	.....	.....	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	126.4	41.8	.....	.....	21
Cn	1	.....	.....	2	N	.....	Y	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	123.0	46.5	.....	2600	23
An	1	NS	.....	1	N	H	.....	.....	24	2	HE	.....	.5	Rot	.....	Luc	N	Luc	.....	103.4	51.3	.....	2500	24
Cy	8	NS	.....	1	N	H	.....	.....	1	2	.....	.....	2.0	Rot	Rot	Luc	N	Luc	.....	100.6	40.1	.....	2900	25
An	.....	.....	DF	1	.....	HM	Y	.....	17	2	Sp	.....	.....	Own	.....	.....	.....	Dow	102.9	.....	41.1	.....	.....	26
An	1	.....	.....	1	.....	HME	Y	.....	13	2	HE	Dry	.....	Rot	.....	Dow	.....	Dow	191.0	70.0	32.3	.....	.....	27
Cy	16	NS	DF	2	.....	.....	N	.....	1	2	Sp	10.0	2.0	Rot	RNB	Own	Ple	Luc	.....	100.5	49.9	1630	.....	28
Cy	10	NS	DF	1	.....	HM	N	.....	1	2	Sp	18.0	2.5	Rot	.....	.....	.....	Luc	129.0	63.4	52.7	2179	.....	29
An	1	NS	DF	1	.....	HME	N	.....	16	.....	HE	Dry	1.5	Rot	.....	Own	.....	Luc	79.3	.....	31.8	555	.....	30
Cy	6	NS	DF	1	N	HM	N	.....	1	2	Sp	Dry	2.0	Rot	.....	Rtl	.....	Luc	.....	158.3	38.0	2435	.....	31
Cy	6	NS	DF	1	N	HM	N	DERD 2482	1	2	Sp	Dry	2.0	Rot	.....	Rtl	.....	Luc	.....	115.5	36.0	1820	.....	32
Cy	6	NS	DF	1	N	HM	N	DERD 2482	1	2	Sp	Dry	2.0	Rot	.....	Rtl	.....	Luc	.....	158.3	36.0	2525	.....	33
Cy	6	NS	DF	1	N	HM	N	JP-1,JP-4	1	2	Sp	Dry	2.0	Rot	.....	Rtl	.....	Luc	.....	115.5	.....	1820	.....	34
Cy	6	NS	DF	1	N	HM	N	JP-1,JP-4,JP-5	1	2	Sp	Dry	1.0	Rot	Eci	Own	.....	Luc	.....	115.5	36.0	1820	.....	35
An	10	NS	DF	1	.....	HM	N	JP-1,JP-4,JP-5	1	2	Sp	Dry	2.0	Rot	.....	.....	.....	Luc	135.0	.....	36.0	1418	.....	36
Cy	6	NS	DF	1	.....	HM	N	JP-1,JP-4,JP-5	1	2	Sp	Dry	.....	Rot	.....	.....	.....	Luc	159.0	.....	36.0	1500	.....	37
Cn	8	.....	DF	.....	.....	.....	.....	K	1	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	126.8	41.3	.....	.....	38
Cn	8	NS	DF	.....	.....	.....	.....	K	1	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	113.3	41.5	.....	4890	39
Cn	8	NS	DF	2	N	M	N	K,JP-1,JP-2	1	2	HE	9.6	.8	Rot	Rot	.....	N	Luc	.....	126.0	44.5	.....	3320	40
Cy	7	.....	DF	1	N	M	N	K	1	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	98.4	37.9	.....	1320	41
Cy	7	NS	DF	1	N	.....	N	K	.....	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	98.4	37.9	.....	1320	42
Cy	7	NS	DF	1	N	.....	N	K	1	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	97.6	37.9	.....	1240	43
Cy	7	NS	DF	1	N	M	N	K,JP-1	1	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	95.0	38.0	.....	1044	44
Cy	7	NS	DF	1	N	M	N	K,JP-1	1	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	97.0	38.0	.....	1110	45
Cy	7	NS	DF	1	N	M	N	K,JP-1	1	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	97.0	38.0	.....	1195	46
Cy	7	NS	DF	1	N	M	N	K	1	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	97.6	37.9	.....	1250	47
Cy	7	.....	DF	1	N	M	N	K	1	2	HE	.....	.....	.....	N	.....	N	Luc	.....	97.6	37.9	.....	1250	48
Cy	7	NS	DF	1	N	M	N	K	1	2	HE	25.0	1.0	Rot	N	.....	N	Luc	.....	97.0	37.9	.....	1250	49
.....	.....	.....	DF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	110.1	39.4	.....	2063	51
.....	.....	.....	DF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	110.1	39.4	.....	2062	52
An	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	HE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	53
An	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	HE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54
An	10	.....	DF	2	.....	M	.....	AVTUR,AVTAG	1	2	HE	31.0	1.2	AR	.....	.....	.....	Luc	.....	134.0	42.0	4674	4542	55
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56
.....	.....	.....	.....	.....	.....	.....	N	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57
An	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	HE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	58
																								59

FP—Furnished by propeller manufacturer.
FrT—Free turbine.
FT—Fir tree.
G—Gasoline.
Gov—Government furnished equipment.
H—Hydraulic.
He—Helical.
HE—High energy.
HM—Hydro-mechanical.
HME—Hydraulic, mechanical and electrical.
HP—Hydro-pneumatic.
HS—Hamilton-Standard.
In—Integral.
JH—Jack and Heints.
K—Kerosene.
Luc—Lucas.
M—Mechanical.
N—None.
Ne—Negligible.
NS—Nimonic sheet.
P—Planetary.
Par—Parker.
Pes—Pesco.
Ple—Plessey.
Pm—Pneumatic.
Pn—Pin.
PT—Pesco or Thompson.
RF—Reverse flow.
RG—Reduction gear.
RI—Rotary injector.
RNB—Rotax, Newton or B. T. H.
Rot—Rotax.
Rtl—Rotol.
S—Single.
SA—Steel alloy.
SB—Spiral bevel.
SG—Spark and glow.
SGP—Spur gear and planetary.
Sp—Spark.
SP—Spark plug.
SpG—Spur gear.
SS—Stainless steel.
T—"T" slot.
TF—Through flow.
Th—Thompson Product.
TJ—Turbo-jet.
To—Torch.
TP—Turbo-prop.
TS—Turbo-shaft.
TuF—Turbo-fan.
Var—Various.
VF—Vertical flow.
W—Welded.
Ww—Woodward.

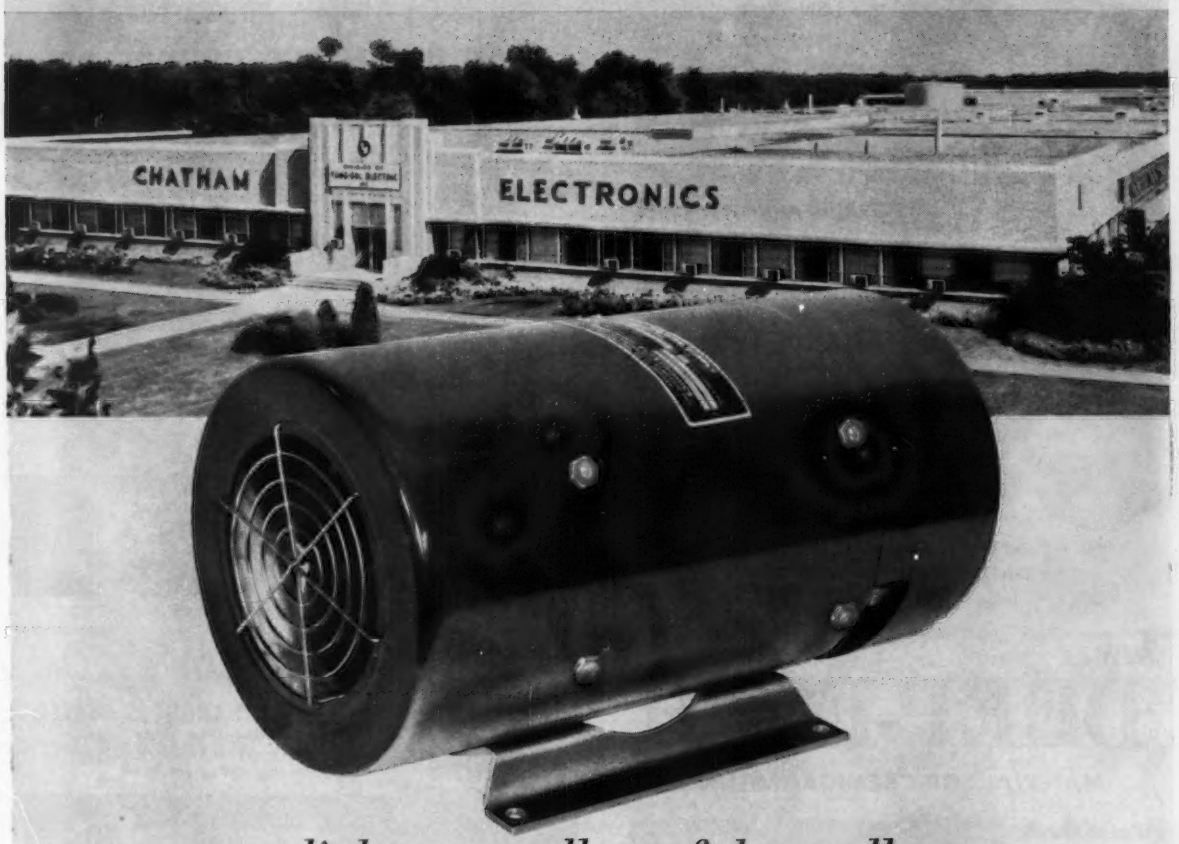
THEORETICAL PERFORMANCE OF ROCKET PROPELLANT COMBINATIONS

(From C. W. Besserer, MISSILE ENGINEERING HANDBOOK, Copyright 1958, D. Van Nostrand Co., Inc., Princeton, N. J., and Rocketdyne, a division of North American Aviation, Inc.)

Oxidizer	Fuel	Specific Impulse, I_{sp}, sec	Specific Impulse × Bulk Density $I_{sp} \times d$, sec × gram/cc	Mixture Ratio	Theor. Combustion Temp., °F	Ratio Specific Heats, $k = \frac{c_p}{c_v}$	Avg. Molecular Wght. of Comb. Prod.	Bulk Density, gram/cc	Exhaust Velocity, fps
Bromine Pentafluoride	Ammonia	235	422	6.0	6660	1.34	29	1.80	7560
85% Chlorine Heptoxide + 15% Nitrogen Tetroxide	Turpentine	250	345	2.8	5900	1.27	24	1.39	8040
Chlorine Trifluoride	Ammonia	240	303	3.0	4980	1.32	22	1.26	7820
	Hydrazine	253	356	2.5	6000	1.33	23	1.48	8140
Fluorine	Ammonia	305	352	3.0	7270	1.33	19	1.16	9820
	Diborane	308	328	5.0	7880	1.30	21	1.07	9910
	Hydrazine	316	410	2.0	7740	1.33	19	1.30	10160
	Hydrogen (Max. $I_{sp}d$)	337	253	19.0	8530	1.34	18	0.75	10840
	Hydrogen (Max. I_{sp})	373	118	4.5	5000	1.33	8.9	0.32	12000
	JP-4	280	335	2.9	7100	1.22	24	1.19	9010
50% Fluorine + 50% Nitrogen Trifluoride	Ammonia	293	337	2.8	6540	1.32	19	1.15	9420
Oxygen Difluoride	Hydrazine	295	365	1.1	6380	1.28	18	1.23	9490
	Ammonia	292	310	1.9	6040	1.29	18	1.07	9400
	n-Octane	300	366	3.8	7340	1.33	20	1.22	9650
RFNA (22% NO_2)	Polyethylene	236	330	4.5	5320	1.22	25	1.40	7600
	JP-4	238	307	4.1	5150	1.23	25	1.30	7660
	80% Diethylenetriamine + 20% Methylamine	243	321	3.0	5250	1.23	24	1.33	7820
	Unsymmetrical Dimethyl-Hydrazine	249	305	2.6	5200	1.23	22	1.23	8020
Nitrogen Tetroxide	Hydrazine	263	314	1.1	4950	1.26	19	1.20	8460
ON 7030 (70% Nitrogen Textroxide + 30% Nitric Oxide	Triethyl-Trithiophosphite	233	296	2.5	6000	1.23	30	1.28	7500
	Methyl Alcohol	239	263	2.1	5210	1.22	25	1.10	7700
	50% Ammonia + 50% Methyl Alcohol	245	258	2.1	5050	1.23	23	1.06	7880
	63% Triethylamine + 37% Orthotoluidine	246	293	3.7	5800	1.24	25	1.19	7920
ON 7030 (70% Nitrogen Textroxide + 30% Nitric Oxide) (cont.)	Turpentine	250	301	3.5	5800	1.25	24	1.21	8040
	Ammonia	250	258	2.1	4900	1.23	21	1.03	8040
	Ethylene Oxide	250	285	2.0	5730	1.24	24	1.14	8040
Oxygen	Ethyl Silicate	244	256	1.6	5700	1.21	26	1.05	7780
	75% Ethyl Alcohol	243	246	1.3	5150	1.22	23	0.99	7920
	Methyl Alcohol	237	250	1.2	5230	1.21	22	0.95	8040
99.6% Hydrogen Peroxide	92.5% Ethyl Alcohol	242	299	4.0	4600	1.20	23	1.24	7790
	JP-4	247	316	6.5	4830	1.20	22	1.28	7940
	Hydrazine	262	324	1.7	4690	1.22	19	1.24	8430
90% Hydrogen Peroxide	Hydrazine	252	301	1.5	4170	1.25	18	1.20	8110
54% Hydrogen Peroxide + 40% Ammonium Nitrate + 6% Water	Kerosene	232	310	9.0	4270	1.21	22	1.34	7460
100% Nitric Acid	Turpentine	235	308	4.4	4950	1.22	25	1.32	7560
95% Nitric Acid	Butyl Mercaptan	223	285	4.0	4780	1.22	27	1.28	7180
RFNA (8.5% NO_2)	n-Octane	236	296	4.5	5100	1.24	24	1.26	7600
RFNA (15% NO_2)	Hydrazine	257	322	1.3	4980	1.25	20	1.26	8270
RFNA (22% NO_2)	Triethyl Trithio Phosphite	224	318	3.0	5520	1.21	30	1.43	7210
	Ammonia	236	262	2.15	4220	1.24	21	1.12	7600
	Turpentine	236	321	4.2	5400	1.22	26	1.36	7600
Oxygen	Nitroethane	251	271	0.65	5570	1.23	23	1.09	8080
	92.5% Ethyl Alcohol	246	252	1.5	5400	1.21	23	0.98	8110
	Nitropropane	255	269	0.9	5620	1.23	23	1.06	8210
	Isopropyl Alcohol	250	258	1.7	5560	1.22	22	0.98	8300
	Propylene Oxide	257	258	1.6	5900	1.23	23	1.00	8300
	69.5% Propylene Oxide + 30.5% Ethylene Oxide	257	260	1.5	5900	1.23	23	1.00	8360
	Ethylene Oxide	257	262	1.1	5750	1.24	22	0.99	8430
	JP-4 (C/H = 6.85)	255	263	2.2	5880	1.24	22	0.98	8460
	JP-4 (C/H = 6.00)	256	263	2.3	5770	1.24	22	0.98	8460
	88% Ethylene Diamine	263	273	1.4	6000	1.23	19	1.04	8460
	Turpentine	262	270	2.4	5880	1.23	22	1.04	8430
	Ammonia	232	264	1.3	4940	1.23	19	0.88	8500
	Methyl Cyclo-Pentane	257	264	2.3	5770	1.24	22	0.98	8500
	n-Octane	254	266	2.4	5790	1.23	22	0.96	8560
	Diethylene-triamine	266	281	1.5	5550	1.24	21	1.06	8560
	Methylamine	247	271	1.6	5460	1.22	20	0.91	8720
	Methyl Acetylene	251	272	2.0	6180	1.27	22	0.93	8750
	Unsymmetrical Dimethyl Hydrazine	261	274	1.4	5650	1.24	20	0.96	8820
	Hydrazine	279	295	0.75	5370	1.25	18	1.06	8980
	Hydrogen (Max. I_{sp} d)	135	316	8.0	5870	1.22	16	0.43	10160
	Hydrogen (Max. I_{sp})	93	363	3.5	4500	1.26	9	0.26	11680
70% Oxygen × 30% Ozone	JP-4	268	278	2.3	5950	1.24	22	1.04	8620
30% Oxygen + 70% Ozone	JP-4	273	294	2.3	6180	1.25	21	1.08	8780
100% Ozone	JP-4	280	318	2.4	6380	1.25	21	1.14	9010
Tetranitromethane	Hydrazine	260	335	1.4	5250	1.27	20	1.29	8360

NEW CHATHAM Y-SERIES

Airborne Transformer Rectifiers



. . . lightest, smallest of them all

Chatham's new bantamweight Y-Series transformer rectifiers weigh up to ⅔ less than competitive models with comparable ratings. And they occupy just ¼ the volume.

These precision miniatures in Chatham's series are rated from 20 amps to 200 amps and deliver 28 volts dc. The 200 amp unit, 28VS200Y, weighs under 17 pounds, measures a trim 11 inches, and occupies only 310 cubic inches. The other units in this series are proportionately lighter and smaller. All the units work off 200 volt, 3 phase, 400 cycle aircraft power supplies.

Only Chatham's exciting departure from conventional transformer design makes the compact Y-Series possible. For the first time a transformer has been designed with a compact symmetrical 'Y' coil configuration. Aside from drastically slicing weight and volume, this remarkable design assures optimum performance by keeping flux linkages uniform while minimizing possible spurious linkages. These characteristics and the quality components engineered into the Y-Series provide for low ripple voltage and produce extremely flat voltage output from no-load to full-load.

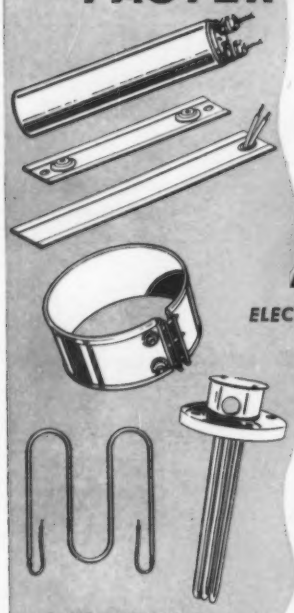
All the silicon rectifiers and the sturdy cast aluminum heat sinks used in the Y-Series were specifically designed for this application. You're sure of getting the highest dependability in the best and most efficient power conversion package. The Y-Series features fan cooling which offers complete mounting flexibility in any attitude. Motor operation is guaranteed for 7500 hours at 71° C and for 2000 hours at 125° C. A very minimum of 10,000 hours and 2500 hours, respectively, is expected.

In addition to the Y-Series TR units, Chatham also makes inverters and other power conversion equipment for missiles and other aircraft industry uses. You can get a complete description of Chatham power conversion equipment by writing for brochure T-26. Chatham Electronics, division of Tung-Sol Electric Inc., Livingston, N. J. Sales Offices: Culver City, Calif., Dallas, Texas. TWX: NK193

CHATHAM ELECTRONICS
division of
TUNG-SOL ELECTRIC INC.

Circle 41 on Inquiry Card

for FASTER HEAT TRANSMISSION



- LESS LAG
- LOW COST
- LIGHT WEIGHT

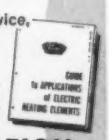
find out about

ACRA

ELECTRIC HEATING ELEMENTS

Most efficient, most economical, for applications in 100° to 1200° F range. Made to highest test standards, uniformly dependable, conform to known U. L. requirements. All types, all sizes, made to order. Engineering service, quotations, on request.

Send for informative HEAT DATA HANDBOOK "D"



ORDER DIRECT FROM

ACRA ELECTRIC CORPORATION

9901 (AM) Pacific Ave., Franklin Park, Ill.

Circle 42 on Inquiry Card

For electronics, aircraft and missile manufacturers . . .

AN UNLIMITED SOURCE OF SKILLED LABOR

Impartial analyses show Metropolitan Miami to be the nation's last unlimited source of skilled, technical labor. Let us show you how this factor, combined with the area's other many advantages, can mean a profitable plant location for *your* firm.

SEND FOR 300 PAGE SURVEY OF THIS DYNAMIC AREA

This important study will be mailed to you, in strictest confidence, if you write, on your letterhead, to the address listed below.

RICHARD I. WELSH, Director

Dade County Development Department

CHAMBER OF COMMERCE BUILDING

345 NORTHEAST SECOND AVENUE • MIAMI 32, FLORIDA

An agency of the Metropolitan Miami government

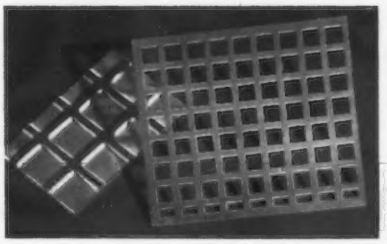
Circle 44 on Inquiry Card

NEW

DEEP-ETCH

MATERIAL FOR CHEMICAL MILLING

Kodak Metal-Etch Resist . . . speeds up, simplifies, opens new chemical milling applications



This photo sensitive resist ends time-consuming handwork, allows close-limit accuracy in deep-etch weight reduction and parts manufacture. Also reproduces fine-line detail as in plating, dial and nameplate making. Withstands acids, alkalies, electrolytic fluids . . . adheres well to aluminum, titanium, magnesium, stainless and other alloy steels. Makes volume production possible because of its high stability, strict uniformity. Send for detailed brochure: *Etching, Chemical Milling & Plating with Kodak Metal-Etch Resist.*

Text for this advertisement was set photographically.

No statement or suggestion is to be considered a recommendation or inducement of any use, manufacture or sale that may infringe on any patents now or hereafter in existence.

Graphic Reproduction Sales Division

EASTMAN KODAK COMPANY

Rochester 4, N. Y.

Kodak

Circle 43 on Inquiry Card

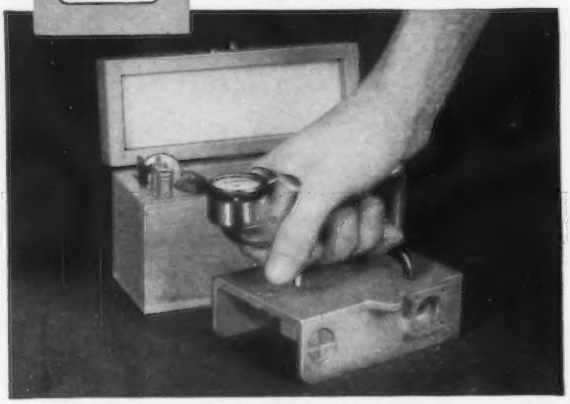
THE MARK OF QUALITY

BARBER COLMAN

Impressor

PORTABLE HARDNESS TESTER

- Rapid testing — no setup
- Easy to carry and use
- Needs only space for hand



A portable hardness tester for aluminum alloys, soft metals, and plastics, the Barber-Colman Impressor is designed for fabricated parts and raw stock testing. Operating experience is not essential. The reading is instantly indicated on the convenient dial. No waiting, preloading, or separate measurements. Barber-Colman engineers will gladly recommend the most suitable model for your application. Write today for complete details.

BARBER-COLMAN COMPANY

Dept. C, 12109 Rock Street, Rockford, Illinois

Circle 45 on Inquiry Card

GD700 SERIES
GAS-O-DOME REGULATORS

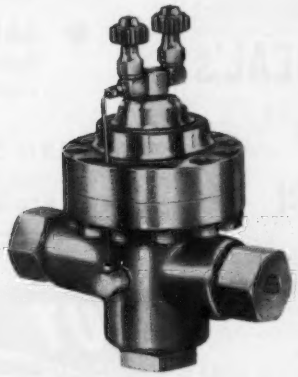
Models in bronze or stainless steel
Pilot operated type
Max. inlet: 7000 to 10,000 psig.
Outlet range: 10-150 to 400-7000 psig.
Flows to 250 scfm.
Low torque: 35 inch-lb. at 7000 psig.
Panel mounting
Bulletins R12 and R18.

BPR SERIES
BACK PRESSURE REGULATORS

Models in bronze or stainless steel
Adjustable relief ranges: From 25-500 psig. to 2000-10,000 psig.
Panel mounting
Bulletin R19

LR SERIES LOADER REGULATORS

Models in bronze or stainless steel
Max. inlet: 7000 to 10,000 psig.
Outlet range: 5-200 to 200-10,000 psig.
Flow: 10 scfm.
Low torque: 35 inch-lb. at 7,000 psig.
60 inch-lb. at 10,000 psig.
Panel mounting
Bulletins R11 and R17

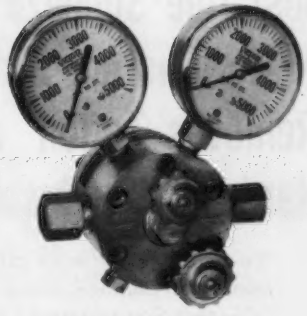


GD90, GD100A AND GD200A
SERIES GAS-O-DOME REGULATORS

Models in bronze or stainless steel
Compensated, high-flow type
Max. inlet and outlet: 6000 psig.
Flows to 80,000 scfm.
Remote control and/or
panel mounting provisions
Bulletin R18

LV-10 LOADER VALVE

Made in bronze only.
Inlet and outlet: 7000 psig.
Flow: 10 scfm.
Fast finger-tip control:
30° clockwise, loads;
30° counter-clockwise, bleeds.
Panel mounting
Bulletin LV-10



GD60 AND 80 SERIES
GAS-O-DOME REGULATORS

Models in bronze
(stainless steel on request)
Inlet and outlet range: 2500 to 10,000 psig.
Flows to 1500 scfm.
Remote control and/or
panel mounting provisions
Bulletin R10A

VICTOR High pressure gas controls

Victor offers you choice of these and many other gas regulators for a wide variety of applications.

All come cleaned for oxygen service; LOX cleaned when specified. Operating temperature ranges: —67° F. to +250° F. (storage —80° F.) Modifications for special applications. Write now for Victor High Pressure Regulator bulletins and Regulator Inquiry Form 361A.

Mfrs. of high pressure and large volume gas regulators; welding & cutting equipment; hardfacing rods; blasting nozzles; cobalt & tungsten castings; straight-line and shape cutting machines.

VICTOR EQUIPMENT COMPANY MISSILE DIVISION

844 Folsom St., San Francisco 7 • 3821 Santa Fe Ave., Los Angeles 58 • 1145 E. 76th St., Chicago 19

J. C. Menzies & Co., Wholly-Owned Subsidiary

Circle 46 on Inquiry Card

Just One Squeeze with IDEAL's New "Custom Stripmaster" Removes Teflon* and Other Hard-to-Strip Insulations

To help prevent wire nicking and insulation damage, these new IDEAL "Custom Stripmasters" are precision drilled on watchmaker's equipment.

With Ideal's new Custom Stripmasters, a light squeeze on the handles strips any wire completely clean and bare up to a full ⅞ inch.

To help prevent nicking and scraping of wires, the Custom Stripmaster's matched sets of blades are precision drilled on watchmaker's equipment to the exact wire sizes. Counterbored blades ride on cut insulation to prevent scratching of stripped wire. Jaws grip wire firmly to prevent insulation damage. 3 models available. Wire sizes from No. 10 to 30.

*Reg. Trademark of DUPONT

Custom Stripmaster® Patented, No. 2,523,936 by IDEAL

IDEAL INDUSTRIES, Inc.
1390-C Park Avenue, Sycamore, Ill.

Gentlemen: Please send catalog information on IDEAL's New "Custom Stripmaster."

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Circle 47 on Inquiry Card

AUTOMATIC ENGINE CONTROLS

- **FULL AUTOMATIC CONTROLS**
  For starting, stopping and protection.
- **D.C. SOLENOIDS**
  Continuous or intermittent.
- **RELAYS AND CONTACTORS**
  Power failure relays and engine cranking controls.
- **SPEED SENSITIVE SWITCHES**
  Overspeed and underspeed. 1, 2 and 3 element.
- **SPECIAL CONTROL PANELS**
  Control systems built to order.
- **SAFETY ALARM SETS**
  Visual and audible alarms for abnormal engine conditions.

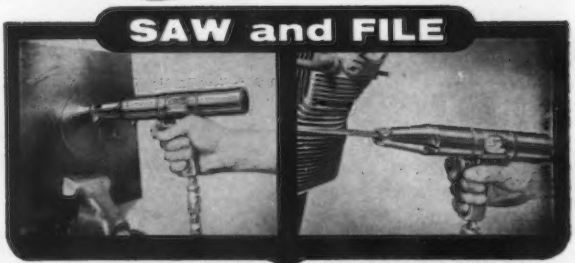
SYNCHRO-START PRODUCTS, INC.
Since 1932
8151 N. RIDGEWAY AVE. • SKOKIE, ILL.

Circle 48 on Inquiry Card

CUT PRODUCTION COSTS..

with an Air Speed TRADE MARK PNEUMATIC

SAW and FILE



CUTS NEAT, TRIM, AND FAST — DIFFICULT FILING SIMPLIFIED

Fast, Accurate Cutting and Filing

Dependable • Portable • Perfectly Balanced

Excellent for key hole, dead-end and scroll cutting in iron, steel, aluminum, copper, plastic, brass, wood, hard fibre and other materials. Operating speed and cutting stroke easily adjustable. Chuck takes standard hacksaw blades, and file can be inserted quickly, replacing blade for filing operation.

Weight: 3½ lbs. — Only two moving parts guarantee long life — Retails for $69.50.

Fully Warranted — Immediate Delivery
Write Now for Free Literature Dept. AM-3

AIR SPEED TOOL COMPANY
1502 W. Stauson Ave., Los Angeles 47, Calif.

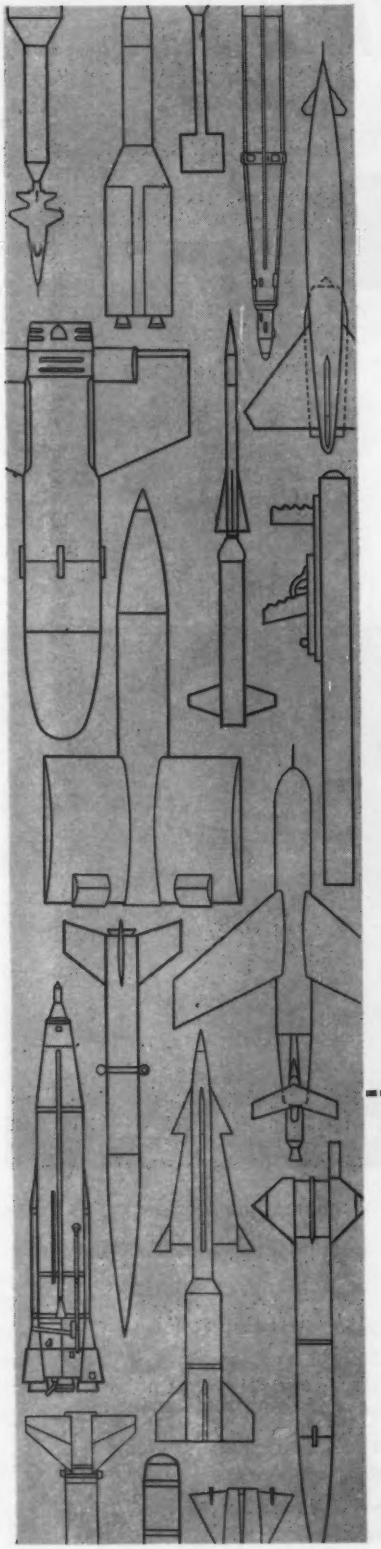
Circle 49 on Inquiry Card

ORDER EXTRA COPIES NOW

OF THIS

1960 AIRCRAFT & MISSILES HANDBOOK

WHILE THEY LAST!



This Information is at your Fingertips:

MISSILE SECTION

U. S. Missiles and Space Projects since World War II including:
Service Assignment—Mission—Current Status.
Current Missiles:
Illustrations—Physical Specifications—Prime and Subcontractors—Dollar Values of Contracts.
All Available Data on Future Missile Projects.
Major Missile Prime and Sub-contractors, including:
Company names—addresses—plant addresses—telephone numbers—descriptions of all projects—dollar value of contracts awarded—project personnel (heads of engineering, production, procurement).

AIRCRAFT SECTION

Specifications on—U. S. and Foreign
Military Aircraft—Rotary Wing Aircraft—Civil Aircraft—Engines (reciprocating and turbine).
Industry Statistics on:
Number and value of civil aircraft shipments—civil engine shipments—unfilled orders of civil aircraft.

PROPULSION SYSTEMS & FUEL SECTION

Specifications on:
Reciprocating Engines—Turbine Engines—Rocket Engines—Fuel Oxidizer Combinations.

GUIDANCE & ELECTRONICS SECTION

Principal types of guidance systems.
Manufacturers of guidance systems.

ORDER YOUR COPIES NOW
WHILE THEY LAST!

PLEASE SEND, while they last _____ copies of the Aircraft & Missiles Handbook Issue for 1960.

☐ **Cash Enclosed** ☐ **Check Enclosed** ☐ **Money Order Enclosed**

All copies are payable in advance at $2.00 per copy—if 10 or more copies are ordered at one time, $1.50 per copy. (These rates for United States and Canada only.) Add $1.00 to above prices for all other Foreign countries.

Name _____ **Title** _____

Company _____ **Dept.** _____

Street Address _____

City _____ **Zone** ____ **State** _____

☐ **Please enter my subscription to AIRCRAFT & MISSILES for one year—$10.00 (United States and Canadian personnel only) and get a copy of this Handbook FREE!**

Mail this to: Aircraft & Missiles, 56th & Chestnut Sts., Philadelphia 39, Pa.

jamesbury
"Double-Seal"™ BALL VALVES

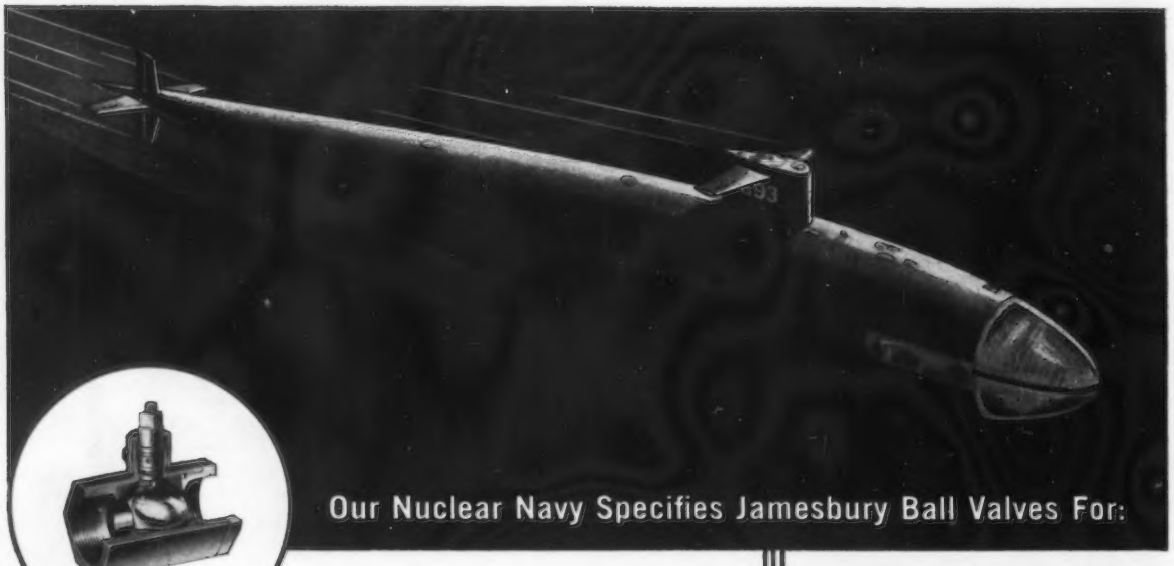
HELPING TO BUILD THE NUCLEAR NAVY

19 Nuclear Submarines in operation or under construction will carry Jamesbury "Double-Seal" Ball Valves.

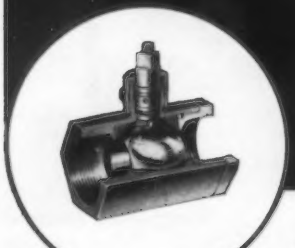
The Jamesbury "Double-Seal" Ball Valve principle solved vital operational problems for our nuclear navy and is today a major factor in the building of our atomic undersea power.

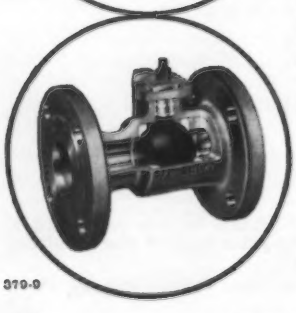
Submarines Served by Jamesbury Include:

GROWLER	SSG577
BARBEL	SS580
BLUEBACK	SS581
BONEFISH	SS582
NUCLEAR SUBS	
SWORDFISH	SSN579
SEADRAGON	SSN584
HALIBUT	SSGN587
SCAMP	SSN588
SCULPIN	SSN590
SHARK	SSN591
SNOOK	SSN592
POLARIS CLASS	
THEODORE ROOSEVELT	SSBN600
ROBERT E. LEE	SSBN601
ABE LINCOLN	SSBN602
THRESHER CLASS	
THRESHER	SSN593
PERMIT	SSN594
PLUNGER	SSN595
POLLACK	SSN596
BARB	SSN603
HADDO	SSN604
JACK	SSN605
TINOSA	SSN606
DACE	SSN607



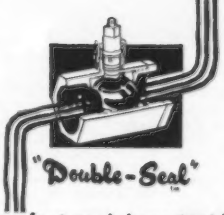
Our Nuclear Navy Specifies Jamesbury Ball Valves For:





Jamesbury High Pressure "Double-Seal" Ball Valves At Work In Air & Hydraulic System.

Unique Jamesbury "Double-Seal" Ball Valves serve throughout Industry. Write today for the Jamesbury brochure "At Your Service".



- compactness of design and size
- dependable, instant 90° on-off
- high impact strength
- easy maintenance
- low operational noise level
- corrosion resistance

• If any or all of these features is important in your valving requirements, then you too can depend on Jamesbury Ball Valves.

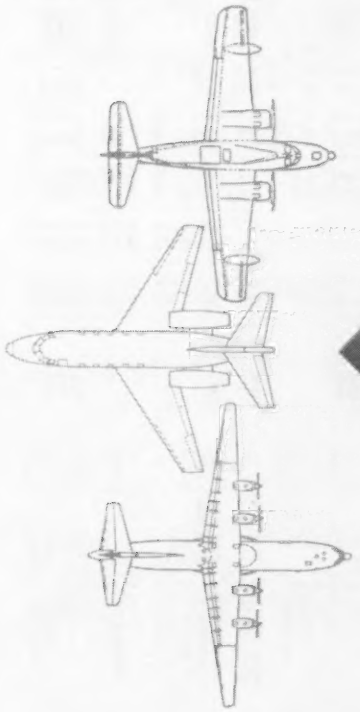
JAMESBURY CORP., 76 New Street, Worcester, Mass.

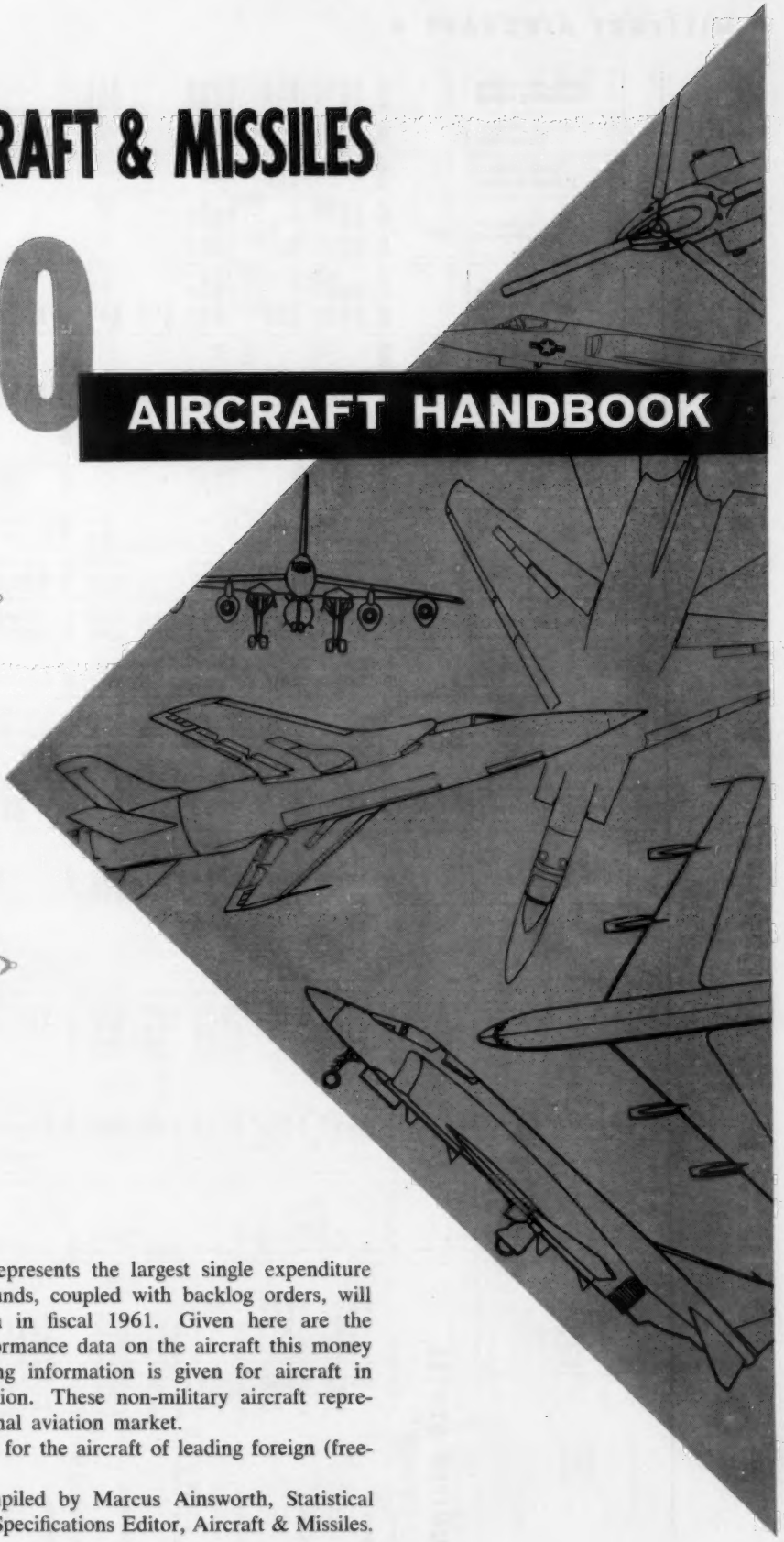
Distributors in Principal Cities

370-9

AIRCRAFT & MISSILES

1960 AIRCRAFT HANDBOOK





Aircraft procurement still represents the largest single expenditure in the military budget. New funds, coupled with backlog orders, will drive spending over $6 billion in fiscal 1961. Given here are the physical specifications and performance data on the aircraft this money will buy. The same engineering information is given for aircraft in general aviation and civil aviation. These non-military aircraft represent a nearly $3 billion additional aviation market.

Specifications are also given for the aircraft of leading foreign (free-world) countries.

These data have been compiled by Marcus Ainsworth, Statistical Editor, and Harold M. Nelson, Specifications Editor, Aircraft & Missiles.

1960...U. S. AND FOREIGN MILITARY AIRCRAFT

MAKE AND MODEL	POPULAR NAME	Type	Number of Crew	ENGINE: Make and Model	ENGINE: Number Used	ENGINE: Total Take-off Hp. at Specified RPM	ENGINE: Total Take-off Thrust at Specified RPM	Fuel Capacity (Gallons)	Oil Capacity (Gallons)	DIMENSIONS (Ft. & In.): Span	Overall Length	Height (Taxi Position)	Wing Area (Gross) Sq. Ft.	Aileron Area (Sq. Ft.)	WEIGHTS (Lb.): Empty	Useful Load	Gross	Pay Load	PERFORMANCE: Maximum Speed at Altitude	Cruising Speed at Altitude	Range in Miles at Cruising Speed	Initial Climb (Feet per Minute)	Service Ceiling with Normal Load (Feet)
UNITED STATES																							
Acme A-2	Avocet	Tr,As,AR,U	2	Cont 420-M	4	N	6000-	1600	5	72.0′	60.0′	19.0′	650.0	85.0	10250	19750	30000	6550	450-25000	400-18000	2800	1800	30000
Beech 45	Mentor T-34A	T	2	Cont O-470-13	1	225-2600	N	50	3	32.8′	25.9′	9.8′	177.6	11.5	2158	794	2950		189-SL	173-10000	737	1230	30000
45	Mentor T-34B	T	2	Cont O-470-4	1	225-2600	N	50	3	32.8′	25.9′	9.6′	177.6	11.5	2254	731	2985		188-SL	170-10000	737	1150	29500
L-23D	Seminole	L,Tr	6	Lyco O-480-1	2	680-3400	N	230	8	45.3′	31.5′	11.4′	277.1	13.9	4460	2022	7000		240-9000	224-14400	1350	1320	1.00
L-23F		Tr	1-2	Lyco IGSO-480-A1A6	2	680-3400	N	230	8	45.9′	33.4′	14.2′	277.1	13.9	4740	2960	7700		239-12000	210-16800	1350	1330	7100
Boeing KC-135	Stratotanker	Ta,TC	4	PW J-57	4	N	40000-	31200		130.8′	136.3′	38.4′	2433.0		96100		297000		600†-	550-	4000†		2000†
B-52	Stratofortress	HB	6	PW J-57	8	N	80000-			185.0′	156.0′	48.0′					400000†		650†-		8000†		7000†
B-52G	Stratofortress	HB	6	PW J-57-P-43W	8	N	80000†-			185.0′	157.6′	40.7′					480000		650†		9000†		39000†
B-52H	Stratofortress	HB		PW	8	N																	
Cessna TL-19D	Bird Dog	OR, IT	1	Cont O-470-15	1	213-2600	N	42	2½	36.0′	25.0′	7.5′	174.0	18.3	1700	700	2400			120-5000	380	1100	18300
OE-2		L	1	Cont SO-475-2	1	265-2600	N	51	4	36.0′	25.2′	7.5′	174.0		1835	815	2650	473	161-10000	132-5000	500		22350
T-37B		T	2	Cont J-69-T25	2	N	2050-21730	317	3	33.8′	27.6′	9.4′	183.9	11.4	4061		6574		355-35000	294-35000	675	3200	39200
L-27A		L	1	Cont O-470-M	2	480-2600	N	130	6	36.0′	27.0′	10.5′	175.0		3140		4830		232-SL	213-8000			20000
Chance Vought F8U-1P	Crusader	P	1	PW J-57	1	N				35.7′	54.3′	15.8′							1000†-				
F8U-2	Crusader	F		PW J-57-P-16	1	N				35.7′	54.3′	15.8′							(2)				
F8U-2N	Crusader	F	1	PW J-57-P-20	1	N				35.7′	54.3′	15.8′							(2)				
Convair B-58	Hustler	B	3	GE J-79	4	N	40000†-	15000†		56.8′	96.8′	31.4′	1542.0						1300†-		(3)		50000†
F-106A	Delta Dart	I	1	PW J-75-P-17	1	N	15000-			38.4′	70.8′	20.3′	631.2	66.6					(4)				50000†
F-106B	Delta Dart	I	2	PW J-75-P-17	1	N	15000-			38.2′	70.8′	20.3′	631.2	66.6					(5)				50000†
Doak VZ-4DA		Re[6]	1	Lyco YT-53-LI	1	N	860-	60	2	25.5′	35.3′	10.4′	96.0	7.0	2300	800	3100	450					
Douglas A3D-2	Skywarrior	B	3	PW J-57	2	N				72.5′	74.4′	22.8′	774.0				70000		700-				
A4D-2	Skyhawk	A	1	Wr J-65	1	N				27.5′	39.4′	15.0′	260.0				15000						
B-66B	Destroyer	B	3	All J-71	2	N		4650		72.5′	75.2′	23.6′	780.0	32.6	42549		78000		600†-				
RB-66B	Destroyer	R	3	All J-71	2	N		4650		72.5′	75.2′	23.6′	780.0	32.6	43476		70000		600†-				
RB-66C	Destroyer	R	4	All J-71	2	N				72.5′	75.2′	23.6′											
WB-66D	Destroyer	W	3	All J-71	2	N				72.5′	75.2′	23.6′	780.0	32.6					600†-				
C-133B	Cargomaster	Tr		PW T34	4	N				179.7′	157.0′	48.0′					286000	91279	359-	323-			
C-133C	Cargomaster	Tr		PW T34-P-9W		N											286000						
Fairchild F-27	Friendship	Tr	3	RR RDa6/MK511	2	3440-14500	N	1320	7½	95.2′	77.2′	27.5′	754.0	37.6	22652	13530	37500	10030	272-20000	272-20000	1917	1340	26500
F-27A	Friendship	Tr	3	RR RDa7/MK528	2	4210-15000	N	1320	7⅝	95.2′	77′1½″	27.5′	754.0	37.6	23202	13167	37500	9667	300-20000	300-20000	1842	1910	29000
Grumman SA-16B	Alabatross	Am,R,C,Tr	6	Wr R-1820-76A	2	2850-2700	N	1671	58	96.7′	61.4′	25.8′	1035.0		22883		29598		220-15000	155-15000	3300	1400	
S2FB-1, S2F-3	Tracker	AS,A	4	Wr R-1820-82A	2	3050-2800	N			72.6′	43.5′	16.7′	499.0	9.3									
F11F-1	Tiger	F	1	Wr J-65-W-7	1	N				31.6′	40.8′	12.7′											
AO-1	Mohawk	OR	2	Lyco T-53-L-3	2	1005-	N			42.0′	42.8′												
WF-2	Tracer	EW	4	Wr R-1820-82A	2		N			72.4′	45.4′	16.8′	520.0	9.6									
Lockheed C-130	Hercules	Tr		All T-56	4		N			132.0′	95.0′	38.2′					108000						
P2V-7	Neptune	Pt,M,TB		Wr R-3350-32W[7]	4		7800-			103.0′	91.4′	29.4′	1000.0[8]		47450		75500		300-				22000
F-104F	Starfighter	F	2	GE J-79	1	N				21.9′	54.8′	13.5′											
F-104G, CF-104	Starfighter	F	1	GE J-79	1	N				21.9′	54.8′	13.5′											
329	Jetstar	Tr	2	GE J-85	4	N		1640		53.7′	58.8′	20.5′	523.0	24.4	14915	13345	28260	2100	600-45000	525-45000	1720	4000	45000
329	Jetstar	Tr	2	Fair J-83	4	N		1640		53.7′	58.8′	20.5′	523.0	24.4	14915	13345	28260	2100	600-45000	525-45000	1720	4000	45000
329	Jetstar	Tr	2	Wr TJ-37-A1	2	9700-	N	1640		53.7′	58.8′	20.5′	523.0	24.4	15139	13681	28820	2100	600-45000	525-45000	1720	4000	45000
P3V-1		AS	10	All T-56-A-10W	4	18000-	N			99.0′			1300.0				125500						

McDonnell	F-101A	Voodoo	FB	1	PW	J-57	2	N	20000†–				39.7′	67.5′	18.0′						1200†–		2000†		50000†
	RF-101A	Voodoo	PR	1	PW	J-57	2	N	20000†–				39.7′	67.5′	18.0′						1000†–		2000†		50000†
	F-101B	Voodoo	I	2	PW	J-57	2	N	20000†–				39.7′	67.5′	18.0′						1000†–				50000†
	F3H-2	Demen	F	1	All	J-71	1	N	10000†–				35.4′	58.9′	14.5′						600†–		2000†		
	F4H-1	Phantom	F,I	2	GE	J-79	2	N	30000†–				38.4′	56.0′	16.3′						1500†–				
North American	T2J-1	Buckeye	T	1–2	West	J-34-WE-36	1	N	3400–	381		38.0′	38.4′	14.0′	255.0	190.0	6500		900†		495–25000	417–34700	958	5000	45000
	A3J-1	Vigilante	AB	2	GE	J-79	2	N				50.0′	70.0′	20.0′							Sup				
	T-39-UTX	Sabreliner	T	2			2	N		850		42.4′	43.8′	16.4′	334.0		8153		15330			500–41000	1400		
	B-70	Valkyrie				J-93	6	N													(9)				70000†
	X-15		Rs	1	RM	XLR-99	1	N				22.0′	50.0′	13.0′	200.0				31275		Hyp				EA
Northrop	T-38	Talon	T	2	GE	J-85	2	N				25.3′	43.0′	11.9′					10960		Sup		1140		45000†
	F-[illegible]J	Scorpion	I	2	All	J-35-A-35	2	N				56.2′	53.4′	17.6′					40000†		600–		1100†		45000†
	N-156F	Freedom Fighter	F	1	GE	J-85	2	N				23.3′	43.0′	11.9′					12000		(4)		750		45000†
Piper	L-21B	Grasshopper		2	Lyco	O-290-D2	1	135–	N	36	2	35.3′	22.5′	6.6′	178.5	18.8	1000	400	1820	620	127-SL	110-SL	500	1200	20000
Republic	F-105B	Thunderchief	FB	1	PW	J-75	1	N	15000–			34.9′	63.1′	19.7′	385.0	15.4					(4)				50000†
	F-105D		FB	1	PW	J-75	1	N	15000–			34.9′	63.1′	19.7′	385.0	15.4					(4)				
	F-105D-5RE	Thunderchief	FB	1	PW	JT4A-29	1	N				34.1′	64.4′	19.8′	385.0	15.4									
Temco	TT-1	Pinto	T	2	Cont	J69-T-2	1	N	920–	124	2	29.8′	30.0′	10.8′	150.0	10.4	3139		4400		330–15000	270–22350	277	1900	30000

AUSTRALIA

deHavilland	DH-115, Mk 33	Vampire	T	2	DH	Goblin 35	1	N	3500–10750	396	1½	38.0′	34.5′	6.3′	261.0	7.7	11050		11050		549–20000	408–40000	850	4500	40000

CANADA

Canadair	CL-28	Argus	AS	15	Wr	981TC-18EA1	4	14800–2900	N	8032	321	142.4′	128.3′	36.7′	2075.0	140.4	81000	67000	148000		288-SL	207-SL	4950	1660	25000
	CL-41	CP-107	T	2	PW	JT-12-J60	1	N	2400–	300	¾	36.4′	32.0′	9.4′	220.0	18.5	4195	2305	6500		463–30000	357–38000	925	4420	45000
	CL-44-6	CC-106	TC	5	RR	Tyne 12	4	22920–15250	N	12190		142.4′	136.6′	38.5′	2075.0	140.4	94537		205000	60463	392–30000	375–30000	4500	1580	22500
	CL-66-B	CC-109	TC	3	Nap	Eland	2	7000–12500	N	2580		105.4′	81.5′	28.2′	920.0	43.8	35187		57500		325–29000	300–20000	1960	2000	28000
	CL-90	CF-104	SR	1	GE	J-79-GE-7	1	N	16000–			121.9′	54.8′	13.5′	196.0	9.5					(4)				
deHavilland	L-20A	Beaver	L,Am,C,P	1	PW	R-985-AN6B	1	450–2300	N	95	6¼	48.0′	30.4′	9.0′	250.0	24.6	2960	2140	5100		163–5000	143–5000	650	1020	18000
	DHC-3	Otter	C,L,Tr,Am,P	1	PW	R-1340-S1H1-G	1	600–2250	N	316	10¾	58.0′	41.8′	12.6′	375.0	26.3	4370	3629	8000		160–5000	139–5000	1008	1000	19000
	DHC-4	Caribou	Tr	2	PW	R-2000-7M2	2	2900–	N	841	37½	46.0′	72.5′	31.8′	912.0		1685	9188	26000	7525		188–7500	1350	1570	24900

FRANCE

Breguet	765	Sahara	Tr		PW	R-2800-CB16, 17	4		N			149.3′	95.4′	33.4′					118800	37500		250–	2500		
	941		Tr	3	DH	Gnome	4	5000–	N	2050		76.1′	70.5′	29.0′	890.0		24100	17200	44000	15000	270–3000	250†–3000	1450		23000
	1005	Taon	F	1	Br	Orpheus 12	1	N				30.0′	43.5′	14.3′					13000						
	1050	Alize	AS	3	RR	Dart Mk 21	1	1975–15000	N			51.2′	45.5′	16.4′	387.5				18100		288–	230–	1550		
Dassault	3-C	Mirage	I	1	Snᵉ	Atar 9	1	N	13200–			27.0′	45.4′		365.0		11640		17600		(4)		821		82000
	4-M	Etendard	F	1	Sn	Atar 8	1	N	9700–			37.4′	47.0′						18000		(5)		1850		
	MD-410	Spirale	T	2	Tur	Bastan	2	1500–33500	340–33500										13230			311–	1540		
	MD-415	Communaute	T,L	2	Tur	Bastan	2	1500–33500	340–33500			53.8′	42.6′	14.1′	387.0		7950		13230	2205		311–9650	1540	2164	38100
	4	Mirage	B		Sn	Atar	2	N													(4)				
	SMB-2	Super Mystere	FB	1	Sn	Atar G	1	N	9700–	524		41.0′	54.8′	14.9′	376.0		15480		20500		(5)	620–	1550		53000
Holste	MH-1521	Broussard	L,Tr,P	1	PW	R-985	1	450–	N			45.0′	28.2′	11.8′	273.4		3373		5952	1655	224–	162–	746	1082	18095
Morane-Saulnier	MS-760	Paris	L,T,P	4	Tur	Marbore 2	2	N	1764–	370	3½	33.3′	33.4′	6.7′	193.8		3164		7496		445–	390–16400	620	3540	39400
	MS-1500	Epervier	OR	2	Tur	Bastan	1	750–33000	N	149	3¾	42.8′	34.8′	10.9′	258.6	28.5	3660	2640	6283		197–4100	182–9850	745	2085	
Nord	3202		T	2	Pot	4-D-32	1	240–	N	52	4	31.2′	26.7′	9.3′	178.7				2690		161–	155–4200	620	1200	
	3400		OR	2			1		N			43.0′	27.8′	10.3′	224.1							125–	620	1380	
	02	Griffon	I		Sn[11]	Atar 101-E3	1	N	7700–	530		26.6′			344.5		10670	4169	14839		(9)				
Potez-Air Fouga	CM-170R	Magister	T	2	Tur	Marbore II	2	N	1764–22600	382		37.0′	33.0′	9.0′	186.0		4755		6976		435–SL			3150	40000
	CM-175	Zephyr	T		Tur	Marbore IIB	2	N	1764–			37.0′	33.0′	9.0′	186.0		4755		6976		435–SL			3150	
S.N.E.C.M.A.	C-450[6]	Coleoptere			Sn	Atar E5V	1	N	8150–			14.7′		26.3′					6614		497–			2560	98400

U. S. AND FOREIGN MILITARY AIRCRAFT—*concluded*

MAKE AND MODEL	POPULAR NAME	Type	Number of Crew	ENGINE: Make and Model	ENGINE: Number Used	ENGINE: Total Take-off Hp. at Specified RPM	ENGINE: Total Take-off Thrust at Specified RPM	Fuel Capacity (Gallons)	Oil Capacity (Gallons)	DIMENSIONS (Ft. & In.): Span	DIMENSIONS (Ft. & In.): Overall Length	DIMENSIONS (Ft. & In.): Height (Taxi Position)	DIMENSIONS (Ft. & In.): Wing Area (Gross) Sq. Ft.	DIMENSIONS (Ft. & In.): Aileron Area (Sq. Ft.)	WEIGHTS (Lb.): Empty	WEIGHTS (Lb.): Useful Load	WEIGHTS (Lb.): Gross	WEIGHTS (Lb.): Pay Load	PERFORMANCE: Maximum Speed at Altitude	PERFORMANCE: Cruising Speed at Altitude	PERFORMANCE: Range in Miles at Cruising Speed	PERFORMANCE: Initial Climb (Feet per Minute)	PERFORMANCE: Service Ceiling with Normal Load (Feet)
FRANCE—*cont'd*																								
Sud-Aviation SO-4050	Vautour	A	1	Sn Atar 103E3	2	N	15434			50.0′	50.0′	15.0′	485.3	38.5	22000	10500	33600		685†			1192	42000†
SO-4050	Vautour	F,B	2	Sn Atar 103E3	2	N	15434	1130		50.0′	50.0′	15.0′	485.3	38.5	22000	10500	46700		685†			1192	42000†
SE-117	Voltigeur	OR,T	2	Tur Bastan	2	1520	N			59.0′	40.4′	18.8′	448.9		9260		12425			285–11500			
SE-118	Diplomate	Tr,T	2	Tur Bastan	2	1500	N			59.0′	44.4′	20.2′	450.7		9920		15340			320–19700	1250		31650
GREAT BRITAIN																								
Armstrong Whitworth AW-660		Tr	3	RR R. Da. 7/2	4	7640–15000	N	3960	15	115.0′	86.8′	27.0′	1458.0	88.0	45350		82000	27000	300–25000	296–22600	3000	1200	22600
FGA-Mk. 6	Sea Hawk	F,B	1	RR Nene		N	5000	545		39.0′	40.0′	8.8′	278.0	20.3			16500		530–40000		500	6000	40000
AVRO B-Mk. 2	Vulcan	B	5	Br Olympus 104/201	4	N	68000		27	111.0′	99.9′	27.1′	3964.0	351.5									
MR-Mk. 3	Shackleton	OR	10	RR Griffon Mk. 57A	4	9740–2756	N	4248	104	119.8′	92.0′	23.4′	1458.0	133.2	57800	42200	100000	11614	302–12000	259–13500	3800	850	19200
Blackburn	Beverley	Tr	4	Br Centaurus 173	4	11400–2800	N	8260	254	162.0′	99.4′	38.8′	2916.0	168.0	82100	52900	135000	45000	238–7500	223–5000	2700	760	15750
NA-39		A	2	DH Gyron Junior	2	N				42.5′	62.4′	16.0′											
Bristol 175-253	Brittania	Tr	9	B-S Proteus R765	4	17800–11650	4720–11650	10330	43	142.4′	124.3′	37.5′	2075.0	140.0	94900	90100	185000	33100	409–22000	397–22000	4640	1550	33000
deHavilland DH-115	Vampire	T	2	DH Goblin 35	1	N	3500–10750	396	1½	38.0′	34.5′	8.3′	261.0	7.7	11050		11150		549–20000	408–40000	850	4500	40000
DH-110	Sea Vixen	F	2	RR Avon	2	N				51.0′	53.5′	14.5′											
English Electric B-2	Canberra	MB	3	RR Avon	2	N	13000–7800	1865		64.0′	65.5′	15.6′					44500		518–			3800	
T-4	Canberra	T	3	RR Avon	2	N	13000–7800	1865		64.0′	65.5′	15.6′					37000		518–			4300	
PR-3	Canberra	PR	2	RR Avon	2	N	13000–7800	2405		64.0′	66.7′	15.6′					44000		518–			3800	
PR-7	Canberra	PR	2	RR Avon	2	N	13000–7800	3305		64.0′	66.7′	15.6′					53000		518–			3600	
B-6	Canberra	B	3	RR Avon	2	N	13000–7800	1865		64.0′	65.5′	15.6′							518–				
B-8	Canberra	AB	2	RR Avon	2	N	13000–7800			64.0′	65.5′	15.6′							518–				
PR-9	Canberra	PR	2	RR Avon	2	N	13000–7800			68.0′	66.7′	15.6′											
T-11	Canberra	RT	2-4	RR Avon	2	N	13000–7800	1865		64.0′	65.5′	15.6′					37000					4300	
T-13	Canberra	T	3	RR Avon	2	N	13000–7800	1865		64.0′	65.5′	15.6′					37000					4300	
P-1A	Lightning	F	1	ArS Sapphire		N				34.8′	49.7′	17.3′											
F-Mk. 1	Lightning	FI	1	RR Avon		N				34.8′	50.0′	19.6′							1200†				
T-Mk. 4	Lightning	FT	2	RR Avon		N				34.8′	50.0′	19.6′							1200†				
Fairey AEW-Mk. 3	Gannet	EW		B-S Double Mamba	1					54.6′	44.0′	16.8′											
Folland FO-141	Gnat	F	1	Br Orpheus 701	1	N	4850			22.2′	29.8′	8.5′	137.0	11.4			6650		(12)				50000
FO-144	Gnat Trainer	T	2	Br Orpheus 100	1	N	4230			24.0′	30.8′	9.7′	175.0	12.7			7500		(12)				
Gloster F(AW)-Mk. 9	Javelin	F	2	B-S Sapphire 7	2	N				52.0′	56.4′	16.0′											
Handley Page HP-80	Victor B-1	B	5	ArS Sapphire	4	N	8000			110.0′	114.9′	26.8′											
HP-80	Victor B-2	B	5	RR Conway	4	N	17250			120.0′	114.9′	26.8′											
Hawker FGA-Mk. 9	Hunter	F	1	RR Avon	1	N				33.7′	45.9′	13.2′	349.0										
FR-Mk. 10	Hunter	F	1	RR Avon	1	N				33.7′	46.1′	13.2′	349.0										
Hunting P-56	Provost	T	2	Av Leonides	1	550–3000	N	78	6	35.2′	28.7′	8.8′	214.0	24.2	3311	989	4300		201–2300	177–11500	633	2100	22500
P-66	Pembroke	Tr	2	Av Leonides	2	1100–3000	N	286	25	64.5′	46.0′	16.1′	400.0	50.2			13500		220–1800	209–	1160	1500	22000
P-84	Jet Provost	T	2	ArS Viper V-8	1	N	1750–13800	334		35.2′	31.9′	10.2′	213.7	18.7			6195		316–30000		570	2530	

Lancashire	EP-9	Prospector	L	1	Lyco	GO-480-G1A6	1	295	N	68¾	3	43.5'	29.8'	8.8'	227.6	22.8	2072	1082	3700	1628	146-SL	120-SL	510	960	12500
Saunders Roe	SR-53		I	1	ArS[13]	Viper	1	N				25.1'	45.0'	10.8'											
Scottish Aviation	CC-Mk. 1	Twin Pioneer	B,Tr	1	Av	Leonides Mk. 128	2	1080-3000	N	440	21¼	76.5'	45.3'	12.3'	670.0	25.4	10200	4200	14600	2880	165-1500	125-5000	940	1170	17300
	CC-Mk. 1	Pioneer	L,Tr	1	Av	Leonides Mk. 130	1	540-3000	N	145	12	49.8'	34.4'	10.3'	390.0	15.0	4200	1600	5800	1015	145-1500	114-5000	685	720	16000
Short	SC-1		Ra	1	RR	RB-08	5	N				23.5'	24.4'												
Vickers-Armstrongs	N-113	Scimitar	F	1	RR	Avon	2	N				37.2'	55.3'	16.0'											
ITALY																									
Aer Macchi	MB-323		T	2	PW	R-1340	1	610-2250	N	106	9¼	39.4'	30.0'	13.3'	217.0	23.0	4409	1301	5710		210-8900	173-13100	1345	1437	21325
	MB-326		T	2	B-S	Viper II	1	N	2500-13800	285	2½	32.9'	34.4'	11.3'	204.5	14.3	5027	2403	7430		440-22000	302-30000	685	4420	40000
Fiat	F-86K		F	1	GE	J47-GE17/B	1	N	7350-			37.2'	40.9'	15.0'	287.9				18000		650-		500		45000
	G-91		F	1	B-S	Orpheus 80302	1	N																	
	G-82		T	2	RR	Nene RN6/21	1	N	5400-12700	465		39.0'	42.4'	13.4'	270.6		9700	4080	13760		575-10000	360-30000	715	6100	42850
	G-91R		PR	1	B-S	Orpheus 80302	1	N	5020-																
	G-91T		T	2	B-S	Orpheus 80302	1	N	4870-	530		28.3'	39.4'	14.0'	176.7		7100	4675	11775		634-	450-30000	798		
Piaggio	P-148MT		T	2	Lyco	O-435-A	1	190-2550	N	45	3	36.4'	27.8'	7.8'	200.0	16.4	1931	715	2646		174-SL	127-3000	570	900	18045
	P-149D		T,L	2	Lyco	GO-480-B	1	270-3400	N	63	3	36.5'	28.2'	9.8'	203.0	16.4	2560	1150	3700	700	190-SL	165-7500	620	1100	15500

ABBREVIATIONS

All—Allison Div.
Am—Ambulance.
AR—Air rescue.
ArS—Armstrong-Siddeley Motors, Ltd.
As—Assault.
AS—Anti-submarine patro.
Av—Alvis, Ltd.
B—Bomber.
Br—Bristol Aeroplane Co., Ltd.
B-S—Bristol-Siddeley.
C—Cargo.
Cont—Continental Motors Corp.
DH—deHavilland Aircraft Co., Ltd.
EA—Extreme altitude.
EW—Early warning.
F—Fighter.
Fair—Fairchild Engine and Airplane Corp.
FB—Fighter bomber.
Fl—Fighter intereptor.
FT—Fighter trainer.
GE—General Electric Co.
HB—Heavy bomber.
Hyp—Hypersonic.
I—Interceptor.
IT—Intereceptor trainer.
L—Liaison.
Lyco—Lycoming Div.
M—Mine layer.
MB—Medium bomber.
N—None.
Nap—D. Napier and Son, Ltd.
OR—Observation and reconnaissance.
P—Photographic.
Pol—Potez.
PR—Photo reconnaissance.
Pt—Patrol.
PW—Pratt and Whitney Aircraft Div.
R—Reconnaissance.
RM—Reaction Motors.
RR—Rolls Royce, Ltd.
Re—Research.
RT—Radar trainer.
SL—Sea level.
Sn—S.N.E.C.M.A.
SR—Strike reconnaissance.
Sup—Supersonic.
T—Trainer.
Ta—Tanker.
TB—Torpedo bomber.
TC—Troop and cargo transport.
Tr—Transport.
Tur—Turbomeca.
U—Utility.
W—Weather.
West—Westinghouse Electric Corp.
Wr—Wright Aeronautical Div.

1—Near Mach 2.
2—Intercontinental with mid-air refueling.
3—Mach 2.
4—Mach 1 plus.
5—Vertical take-off and landing aircraft.
6—Also two Westinghouse J-34 engines.
7—Includes aileron.
8—Mach 3.
9—Also one S.E.P.R. rocket engine.
10—Combination turbo-jet, ram-jet engine.
11—Near Mach 1.
12—Also one deHavilland Spectre rocket engine.
A—Attack.
AB—Attack bomber.

KOHLER
PRECISION
CONTROLS

Relied upon for
quality,
engineering,
workmanship

Kohler Precision Controls include a wide range of valves, fittings and parts in various types and sizes for industrial equipment, automotive, aircraft and missile applications. Complete facilities in one plant, with unified supervision, contribute to maximum control in maximum control in prompt deliveries. Ultra-sonic cleaning facilities. Air filtered to 10 microns in area where hydraulic system components are assembled, tested and packaged.

KOHLER CO. *Established 1873* KOHLER, WIS.

Send for catalog with complete data on:

CHECK VALVES
Cone Type
Soft Seat Type
Swing Type
PRESSURE RELIEF VALVES
RESTRICTOR VALVES
JET ENGINE PARTS
AIR VALVES
NEEDLE VALVES
ENGINE PRIMERS
PLUG VALVES

KOHLER OF KOHLER
Enameled Iron and Vitreous China Plumbing Fixtures • Brass Fittings • Electric Plants • Air-cooled Engines • Precision Controls

Circle 51 on Inquiry Card

1960 . . . U.S. AND FOREIGN ROTARY WING AIRCRAFT

MAKE AND MODEL	GENERAL				ENGINE			MAIN ROTOR								ANTI-TORQUE ROTOR					WEIGHTS (Lb.)			PERFORMANCE							LANDING GEAR	
	Number of Seats	Fuel Capacity (Gal.)	Octane Number Recommended	Oil Capacity (Gal.)	Make and Model	Number Used	Rated Hp. at Specified R. P. M.	Number Used	Location	Blades per Rotor	Diameter of Rotor (Ft. In.)	Blade Area (Sq. Ft.)	Type (if more than one used)	Rotor R. P. M. at Cruising Speed	Disc Area (Sq. Ft.)	Number of Blades	Rotor Diameter (Ft. In.)	Blade Area (Sq. Ft.)	Rotor R. P. M. at Cruising Speed	Disc. Area (Sq. Ft.)	Gross (Normal Load)	Empty	Useful Load	Max. Speed at Altitude	Cruising Speed at Altitude	Fuel Consumption Cruising Speed (Lb./hr.)	Range (Miles) at Cruising Speed	Rate of Climb: Maximum (Ft./min.)	Rate of Climb: Vertical (Ft./min.)	Service Ceiling—Normal Load	Type	Tread—Main Gear
UNITED STATES																																
Bell 47G-2 (H-13H)	3	41	87	2	Lyco VO-435	1	200-3100	1	C	2	35.1′	32.2	....	340	969	2	5.8′	2.3	1660	27.3	2450	1564	886	100-SL	85-SL	90	238	805	....	12300	S	7.5′
47G-3	3	41	100	3	Frank 6VS-335	1	225-3100	1	C	2	37.2′	34.3	....	333	1085	2	5.8′	2.3	1660	27.3	2650	1540	1110	100-SL						23000†	S	7.5′
47J (HUL-1) (H-13J)	4	48	87	3	Lyco VO-435	1	220-3200	1	C	2	37.2′	34.3	....	333	1085	2	5.8′	2.3	1920	27.3	2850	1640	1210	105-SL	93-5000	96	239	630	....	9300	S	7.5′
47J-2	4	48	87	4½	Lyco VO-540	1	220-3200	1	C	2	37.2′	34.3	....	333	1085	2	5.8′	2.3	1920	27.3	2850	1710	1140	105-SL							S	7.5′
204 (HU-1A)	6-10	125	JP4	2½	Lyco T53-L-1	1	770-6400	1	C	2	44.0′	55.0	....	314	1520	2	8.5′	6.0	1604	56.8	6100	3850	2250	120-SL	115-SL	....	210†	2100†	1400†	17000	S	8.4′
V-3	2	103	91	7	PW R985	1	450-2300	2	SS	2	23.0′	42.4	....	B	831	....	....	....	....	....	4800	3600	1200	178-5000	135-SL	....	....	1000†	....	....	S	4.0′
Brantly B-2	2	30	91	1½	Lyco VO-360-A1A	1	180-2900	1	C	3	28.7′	23.9	....	470	445	2	4.3′	1.0	2900	17.5	1600	960	640	100†-	100-	54	300	1350	1580	9750	S	5.7′
Cessna CH-1C	4	60	91	3	Cont FSO-526-A	1	270-3200	1	....	2	35.0′	37.9	....	367	962	2	7.0′	3.1	1636	38.5	3100	2067	1033	124-8000	100†-	120	285	950	330	15200	S	8.4′
YH-41	4	60	91	3	Cont FSO-526-A	1	270-3200	1	....	2	35.0′	37.9	....	367	962	2	7.0′	3.1	1636	38.5	3000	2132	868	124-8000	100†-	120	290	1030	440	16100	S	8.4′
Doman LZ5-5	8	119	100	7	Lyco GSO-720-A1A	1	520-3400	1	C	4	48.0′	73.6	....	205	1810	3	10.0′	6.2	1090	78.5	5500	3250	2250	115-SL	107-10000	186	390	850	....	10500	QT	7.5′
YH-31	8	119	100	7	Lyco GSO-720-A1A	1	520-3400	1	C	4	48.0′	73.6	....	205	1810	3	10.0′	6.2	1000	78.5	5200	3387	1613	76-1500	76-1500	124	310	850	....	9100	QT	7.5′
Gyrodyne YRON-1	1	5	....	....	Por GP-702-1	1	62-4000	2	....	2	17.0′	14.0	CA	640	227	....	....	....	....	....	700	440	260	68-SL	55-SL	23½	60	610	500	6500	Tri	5.4′
Hiller H-23D	3	46	91	3½	Lyco VO-435-A1C	1	250-3200	1	C	2	35.4′	33.8	....	359	980	2	5.5′	2.7	2230	23.8	2700	1816	884	95-SL	82-SL	90	197	1050	590	13200	S	7.5′
YRDE-1	1	2½	87	¼	Nel H-23B	1	45-4000	1	C	2	18.5′	8.6	....	541	271	2	3.0′	.9	3250	7.1	556	300	256	70-SL	52-SL	26½	27	1160	680	13200	Tri	8.4′
12E	3	46	87	2¼	Lyco VO-540-B1A	1	305-3200	1	C	2	35.4′	33.8	....	381	980	2	5.5′	2.7	2292	23.8	2700	1700	1000	96-....	82-SL	94	215	1550	....	15500	S	7.5′
X-18	....	....	....	....	All[3] T-40	2	5035-....	....	....	....	....	....	....	....	....	....	....	....	....	....	33000	....	....	....	....	....	....	....	....	....	Tri	....
Hughes 269A	2	25	91	2	Lyco O-360	1	180-2700	1	C	3	25.0′	21.1	....	450	491	2	3.4′	1.0	4138	8.7	1550	915	635	90-....	83-5000	61	200	1450	400	11500	S	6.0′
Kamen H-43A	5	100	100	....	PW R-1340-48	1	600-....	2	....	2	47.0′	122.9	Int	240	1901	....	....	....	....	....	5800	4040	1760	95-8000	65-....	....	220	1300	800	18000	Qua	8.2′
H-43B	8	200	JP4	2	Lyco T53-L-1A	1	860-6680	2	....	2	47.0′	122.9	Int	235	1931	....	....	....	....	....	5870	4278	1592	104-SL	98-SL	430	184	2000	1540	25700	Qua	8.4′
HU2K	6	276	JP4	....	GE YT-58-6	1	1024-6000	1	....	4	44.0′	....	....	....	....	3	8.0′	....	....	....	7378	5052	2326	....	....	....	....	....	....	....	Tri	10.8′
K16B	....	....	....	....	GE YT-2A	2	1025-6000	2	FW	3	15.0′	....	....	650	....	N	....	....	....	....	9300	....	....	248-15000	....	....	....	5000	950	35000	TW	....
Rotodyne[6]	54-65	1490	JP4	37	RR Tyne	2	5250-....	1	....	4	104.0′	....	....	130	8495	N	....	....	....	....	53500	34765	18735	....	200-2000	2544	275	2500	2500	17000	TT	26.2′
McDonnell XV-1	4	90	145	6	Cont R-985-19	1	525-2600	1	C	3	31.0′	68.0	....	400	750	4	1.3′	.3	0	1.2	5505	4277	1228	170-SL	138-SL	380	....	1300	300	....	S	4.7′
120	1	212	JP4	....	AR[4] GTC 85-36	3	740-....	1	....	3	31.0′	68.0	....	415	750	N	....	....	....	....	5000	2450	2550	138-SL	109-SL	1000	98	2400	1500	17500	S	9.2′
Omega BS-12D	5	80	91	6	Lyco O-540-F1B5	2	260-2800	1	C	4	39.0′	50.0	....	318	1195	2	8.0′	3.4	1350	50.0	4850	3400	1450	92-SL	80-....	192	200	940	....	9000	Tri	12.0′
BS-12E	5	80	100	4	Frank 6AS-335	2	225-3100	1	C	4	39.0′	50.0	....	318	1195	2	8.0′	3.4	1350	50.0	4850	3300	1550	92-SL	80-....	144	275	835	....	12000	Tri	12.0′
Republic SE-3130[5]	5	153	JP4	2	Tur Artouste IIB1	1	400-34000	1	C	3	33.4′	34.0	....	360	880	2	5.9′	....	2090	....	3300	1900	1400	110-....	100-....	315	330	1000	....	20000	S	6.8′
Sikorsky S-55C	12	185	80	9½	PW R-1340	1	600-2250	1	C	3	53.0′	....	....	194	2206	2	8.8′	....	1360	59.1	7200	4950	2250	101-SL	85-SL	228	400	700	....	10500	Qua	11.0′
S-58B	20	198	145	10½	Wr R-1820-84	1	1525-2800	1	C	4	56.0′	....	....	224	2460	4	9.5′	....	1330	68.7	13000	7630	5370	123-SL	98-SL	528	182	1100	200	9500	Conv	12.8′
S-56	36	400	145	40	PW R-2800	2	2100-2700	1	C	5	72.0′	....	....	185	4071	4	15.0′	....	840	177.0	31000	20690	10310	130-SL	115-SL	1500	145	910	....	8700	Conv	19.8′
S-55A	12	185	91	9½	Wr R-1300	1	800-2600	1	C	3	53.0′	....	....	194	2206	2	8.8′	....	1360	59.1	7500	5250	2250	112-SL	91-SL	258	360	1020	100	10600	Qua	11.0′
S-60	2	666	145	70	PW R-2800	2	2100-2700	1	C	5	72.0′	....	....	185	4071	4	15.0′	....	840	177.0	31200	9000	12200	130-SL	115-SL	1500	265	910	....	10300	Tri	19.8′
S-61	25	420	JP4	6½	GE T-58-GE-8	2	1250-1955	1	C	5	62.0′	....	....	202	3019	5	10.0′	....	1240	78.5	18700	10259	8441	150-SL	135-SL	1060	285	1640	600	9500	Tri	13.0′
S-62	12	182	JP4	3	GE T-58-GE-6	1	1050-1955	1	C	3	53.0′	....	....	212	2206	2	8.8′	....	1484	59.1	7500	4550	2950	124-SL	115-SL	455	260	1380	600	15700	Tri	12.2′
Vertol H-21B	22	300	100	....	Wr 1820-103	1	1425-2700	2	Tan	3	44.0′	....	Tan	....	....	N	....	....	....	....	13500	8600	4700	130-SL	98-5000	....	370	1100†	900†	10000	Tri	....
H-21C	22	300	100	....	Wr 1820-103	1	1425-2700	2	Tan	3	44.0′	....	Tan	....	....	N	....	....	....	....	13500	8730	4570	130-SL	98-5000	....	370	1100†	900†	10000	Tri	....
44	15-19	300	100	....	Wr R-1820-103	1	1425-2700	2	Tan	3	44.0′	....	Tan	....	....	....	....	....	....	....	14300	8980	5420	127-SL	102-SL	....	399	....	....	10600	....	....
107 Model 11	25	....	....	....	GE CT-58	2	....	2	Tan	3	50.0′	....	Tan	....	....	....	....	....	....	....	18400	....	....	150-....	....	....	....	1700	760	13700	....	....
FRANCE																																
Sud-Aviation SO-1221	2	66	....	2	Tur Palouste IV	1	250-34000	1	C	2	36.0′	....	....	....	1022	N	....	....	....	....	1764	794	970	81-SL	62-SL	198	112	500	....	14000	S	8.4′
SE-3130	5	....	....	....	Tur Artouste II	1	390-34000	1	C	3	33.5′	....	....	320	....	2	....	....	320	....	3300	1874	1426	113-SL	106-....	....	370	1180	....	15100	S	....
SE-3160	....	....	....	....	Tur Artouste IIIB	1	450-....	1	C	3	36.1′	....	....	....	....	3	....	....	....	....	4190	2300	....	....	124-....	....	330	....	....	....	Tri	....
SE-3200	20†	....	....	....	Tur Turmo III	3	750-....	1	C	4	49.2′	....	....	....	....	4	....	....	....	....	16550	9900	....	137-....	125-....	....	300†	....	....	....	Tri	....

| | | |

1960 . . . U. S. AND FOREIGN CIVIL AIRCRAFT

MAKE AND MODEL	Type	Number of Crew	Number of Seated Passengers	ENGINE: Make and Model	ENGINE: Number Used	ENGINE: Total Take-off Hp. at Specified RPM	ENGINE: Total Take-off Thrust at Specified RPM	Fuel Capacity (Gal.)	Oil Capacity (Gal.)	DIMENSIONS (Ft. & In.): Span	Overall Length	Height (Taxi Position)	Wing Area (Gross) Sq. Ft.	Aileron Area (Sq. Ft.)	WEIGHTS (Lb.): Empty	Useful Load	Gross	Pay Load	PERFORMANCE: Maximum Speed at Altitude	Cruising Speed at Altitude	Range in Miles at Cruising Speed	Initial Climb (Ft. per Min.)	Service Ceiling with Normal Load (Ft.)
UNITED STATES																							
A.C.M.E. A-1	ET-LS	1	8	Cont. Turbofan 420-M	2	N	2500-	660	8	47.0′	39.0′	11.5′	260.0	36.0	4115	4885	10300	2200	471-25000	400-17000	1650	2000	25000
A-2	PC-LS	2	26	Cont. 420-M	4	N	6000-	1600	5	72.0′	60.0′	19.0′	650.0	85.0	10250	19750	30000	6550	450-25000	400-18000	2600	1800	30000
Aero Commander 500	P-L	1	6	Lyco O-540-A1A	2	500-2575	N	156	3	49.5′	35.1′	14.5′	255.0	19.8	3900	2100	6000	.....	218-SL	205-10000	1100	1400	22500
560E	P-L	1	6	Lyco GO-480-G1B6	2	590-3400	N	223	8½	49.5′	35.1′	14.5′	255.0	19.8	4300	2200	6500	.....	222-SL	212-10000	1625	1450	22500
680E	P-L	1	6	Lyco GSO-480-B1A6	2	680-3400	N	223	8½	49.5′	35.1′	14.5′	255.0	19.8	4475	3925	7500	.....	255-10000	226-10000	1480	1525	25360
720	P-L	1	5	Lyco GSO-480-B1A6	2	680-3400	N	223	8½	49.5′	35.1′	14.5′	255.0	19.8	5330	2170	7500	.....	255-10000	226-10000	1400	1525	25360
Bee Aviation Honey Bee	P-L	1	N	Cont. A-65	1	65-	N	8½	1	28.0′	18.0′	7.7′	96.0	5.4	610	250	8[illegible]	200	120-	110-	240	1000	15000
Wee Bee	P-L	1	N	Kle O-45-35	1	30-	N	2½	.....	18.0′	15.0′	3.0′	44.0	2.2	210	210	4[illegible]	200	82-	72-	50	300	9000
Queen Bee	P-L	1	3	Lyco O-320	1	150-	N	42	1	32.8′	22.1′	8.0′	130.0	5.8	1190	960	215[illegible]	840	170-	160-	700	1000	18000
Beech D50C	PC-L	1	5	Lyco GD-480-G2D6	2	590-3400	N	180	6	45.4′	31.5′	11.4′	277.1	13.9	4100	2200	6300	.....	214-2500	203-7000	1650	1450	20300
G18S	PC-L	1-2	6	PW R-985AN-14	2	900-2300	N	318	16	49.7′	35.3′	9.5′	361.0	17.5	5950	3750	9700	.....	233-4500	215-10000	1585	1410	23100
H50	PC-L	1	5	Lyco 1GSO-480-A1A6	2	680-3400	N	230	8	45.4′	31.6′	11.4′	277.1	13.9	4480	2820	7300	.....	235-12000	223-15200	1650	1270	28000
B95	PC-L	1	3	Lyco O-360-A1A	2	360-2700	N	112	4	37.8′	25.4′	9.5′	199.2	11.5	2635	1465	4100	.....	210-SL	200-7500	1410	1300	18700
M35	P-L	1	3	Cont. 10-470-C	1	250-2600	N	68	2½	33.5′	25.2′	6.6′	180.0	11.5	1832	1118	2950	.....	210-SL	200-7000	1245	1170	20000
MS-760	ET-L	1	3	Tur Marbore IIC	2	N	1660-22600	370	3¾	33.3′	32.9′	8.5′	194.0	15.3	4487	3013	7500	.....	415-18000	341-15000	933	2400	25000
33	P-L	1	3	Cont. 10-470-J	1	225-2600	N	68	2½	32.8′	25.5′	8.3′	177.6	11.5	1730	1170	2900	.....	195-SL	185-7000	1170	1010	19300
65	ET-L	1-2	4-5	Lyco 1GSO-480-A1A6	2	680-3400	N	230	8	45.9′	33.4′	14.2′	277.1	13.9	4740	2960	7700	.....	239-12000	214-15200	1210	1300	27000
Ballanca 14-19-3	P-L	1	3	Cont. 10-470-F	1	260-2625	N	60	3	34.2′	22.9′	6.4′	161.5	11.8	1690	1010	2700	.....	208-9200	203-9200	880	1750	22000
Boeing 707-120	PC-L	3	100-179	PW JT3C-6	4	N	52000-	17400	.....	130.8′	134.5′	38.4′	2433.0	.....	107712	.....	248000	42700	.....	591-	3000†	.....	40000†
707-120B	PC-L	4	121-179	PW JT3D-1	4	N	68000-	17400	.....	130.8′	144.5′	38.7′	2433.0	.....	120734	.....	258000	49266	.....	615-	3000†	.....	.....
707-220	PC-L	.....	100-179	PW JT4A-3	4	N	63200-	18078	.....	130.8′	134.5′	38.4′	2433.0	.....	.....	.....	248000	42000	.....	605-	.....	.....	40000†
707-320	PC-L	4	108-189	PW JT4A-3	4	N	63200-	23580	.....	142.4′	152.9′	38.7′	2908.0	.....	125560	.....	296000	40000	.....	605-	4000†	.....	40000†
707-420	PC-L	4	108-189	RR Conway Mk. 505	4	N	66000-	23580	.....	142.4′	152.9′	38.7′	2900.0	.....	124020	.....	296000	40000	.....	606-	4000†	.....	40000†
720	PC-L	3	88-165	PW JT3C-7	4	N	48000-	10092	.....	130.8′	136.4′	38.4′	2433.0	.....	99919	.....	203000	33000	.....	615-	2400†	.....	40000†
720B	PC-L	4	88-165	PW JT3D-1	4	N	68000-	11832	.....	130.8′	136.4′	38.4′	2433.0	.....	109580	.....	222000	37420	.....	615†-	3000†	.....	40000†
Call Air A-5	DS-L	1	1	Lyco O-320-A2A	1	150-2700	N	25	2	35.5′	24.1′	7.8′	186.1	11.8	1020	1130	2150	850	105-7000	100-	300	810	15000
A-6	DS-L	1	1	Lyco O-360-C1A	1	180-2700	N	40	2	35.5′	24.1′	7.8′	186.1	11.8	1170	1180	2350	850	115-7000	105-7000	400	1000	17000
Cessna 150	PC-L	1	1	Cont. O-200-A	1	100-2750	N	26	1¼	33.4′	21.5′	6.9′	160.0	.....	946	554	1500	.....	124-SL	121-9000	520	740	15300
172	PC-LS	1	3	Cont. O-300-C	1	145-2700	N	42	2	36.0′	26.4′	8.9′	174.0	.....	1252	948	2200	.....	140-SL	131-8000	545	730	15100
175	PC-LS	1	3	Cont. GO-300-C	1	175-3200	N	52	2½	36.0′	26.4′	8.7′	174.0	.....	1339	1011	2350	.....	147-SL	140-10000	590	850	15300
Skylark	PC-LS	1	3	Cont. GO-300-C	1	175-3200	N	52	2½	36.0′	26.4′	8.7′	174.0	.....	1420	930	2350	.....	149-SL	142-10000	595	850	15300
180	PC-LS	1	3	Cont. O-470-L	1	230-2600	N	65	3	36.0′	26.0′	7.5′	174.0	.....	1530	1120	2650	.....	170-SL	160-8000	675	1130	21500
182	PC-L	1	3	Cont. O-470-L	1	230-2600	N	65	3	36.0′	27.1′	9.8′	174.0	.....	1550	1100	2650	.....	167-SL	157-8000	660	1030	19300
Skylane	PC-L	1	3	Cont. O-470-L	1	230-2600	N	65	3	36.0′	27.1′	9.8′	174.0	.....	1632	1018	2650	.....	170-SL	160-8000	675	1030	19300
210	PC-L	1	3	Cont. 10-470-E	1	260-2625	N	65	3	36.5′	27.4′	8.8′	175.5	.....	1735	1165	2900	.....	199-SL	190-7000	755	1300	20700
310D	PC-L	1	3-4	Cont. 10-470-D	2	520-2625	N	100	6	36.0′	29.6′	9.9′	175.0	.....	3037	1793	4830	.....	242-SL	220-8000	825	1800	21300
Champion 7EC, 7FC	PC-LS	1-2	1	Cont. C90-12F	1	95-2625	N	26	1½	33.4′	21.7′	8.0′	340.0	32.0	890	560	1450	.....	135-SL	112-5000	500†	900	15500
7GC	PC-LS	1	1-2	Lyco O290-D2B	1	140-2800	N	39½	2	33.4′	22.1′	.....	340.0	32.0	931	719	1650	482†	162-SL	128-7000	580	1040	16882
7HC	PC-L	1	1-2	Lyco O290-D2B	1	140-2800	N	39½	2	33.4′	22.1′	.....	340.0	32.0	952	698	1650	461†	162-SL	128-7000	580	1040	16882
7GC-A	PC-LS	1	1-2	Lyco O-320	1	150-2700	N	39½	2	35.5′	22.1′	8.0′	330.0	32.0	950	1250	2200	1144	162-SL	130-7000	640	1110	18100
Convair 880	PC-L	6	88-110	GE CJ-805-3	4	N	44800-	10770	28	120.0′	129.4′	36.4′	2000.0	.....	84300	.....	184500	23150	615-22500	556-35000	3450	3700	40000
600	PC-L	6	96-121	GE CJ-805-23	4	N	64400-	15110	28	120.0′	139.4′	39.5′	2250.0	.....	110750	.....	238200	25120	635-21500	570-35000	4400	3200	40000
Douglas DC-8 Domestic	PC-L	8	118	PW JT3C	4	N	.....	17600	.....	142.4′	150.5′	42.4′	2770.6	.....	118955	.....	273000	33620	561-30000	.....	3790	.....	45000
DC-8 Intercontinental	PC-L	9	132	PW JT4A-3	4	N	.....	21615	.....	142.4′	150.5′	42.4′	2770.6	.....	130092	.....	300000	35930	589-30000	.....	5000	.....	.....
DC-8 Domestic	PC-L	8	144	PW JT4A-3	4	N	.....	17600	.....	142.4′	150.5′	42.4′	2770.6	.....	124977	.....	276000	37910	589-30000	.....	3790	.....	45000
DC-8 Intercontinental	PC-L	9	144	PW JT3D	4	N	.....	23307	.....	142.4′	150.5′	42.4′	2770.6	.....	128082	.....	310000	37910	591-30000	.....	6000	.....	45000
DC-8 Intercontinental	PC-L	9	144	RR Conway	4	N	.....	23307	.....	142.4′	150.5′	42.4′	2770.6	.....	128082	.....	310000	37910	591-30000	.....	5500	.....	45000
Fairchild F-27	PC-L	3	40	RR RDa6/Mk. 511	2	3440-145000	N	1320	7½	95.2′	77.2′	27.5′	754.0	.....	22652	13530	37500	10030	272-20000	272-20000	1917	1340	26500
F-27A	PC-L	3	40	RR RDa7/Mk. 528	2	4210-15000	N	1320	7½	95.2′	77.2′	27.5′	754.0	.....	23202	13167	37500	9667	300-20000	300-20000	1842	1191	29000
Goodyear GA-468	.....	1	.....	Nelson	1	42-	N	20	.....	22.0′	19.8′	7.0′	110.0	.....	225	200	550	225	72-SL	60-SL	550	6½	10300
Grumman 159	PE-L	2	10-19	RR Dart RDa7/2	2	2200-	N	1540	7	78.5′	64.0′	22.8′	615.0	37.0	21770	11830	33600	4880	365-25000	350-25000	2200	2000	35000
Ag Cat	DS-L	1	.....	Cont. W-670	1	220-2075	N	33	5	35.7′	24.4′	10.8′	326.0	31.5	2127	1573	3700	1200	110-	.....	.....	530	.....

Helio	H-395A	PC-LS	1	4	Lyco	GO-435-C2B2-6	1	260-3400	N	60	2½	39.0′	30.6′	8.8′	231.0	20.7	1990	1010	3000	.....	166-SL	157-6200	600	1240	20900
	H-395	PC-L	1	4	Lyco	GO-480-G1D6	1	295-3400	N	60	2½	39.0′	30.8′	8.8′	231.0	20.7	2040	960	3000	.....	176-SL	170-8200	506	1550	23500
Lake	C-2	ET-LS	1	3	Lyco	O-360-A1A	1	180-.....	N	40	2	34.0′	23.5′	10.8′	155.0	10.7	1525	825	2350	.....	135-8500	130-8500	520	850	15000
Lockheed	188A	P-L	3	66-99	All	501-D13	4	15000-13820	N	6420	26	99.0′	104.6′	32.8′	1300.0	.....	55993	57007	116000	27000	432-.....	405-22000	2800	2150	32000
	329	PC-L	2	10	GE	J-85	4	N	.....	1640	.....	53.7′	56.8′	20.5′	523.0	24.4	14915	13345	28260	2100	600-45000	525-40000	1710	4000	45000
	329	PC-L	2	10	Fair	J-83	4	N	.....	1640	.....	53.7′	56.8′	20.5′	523.0	24.4	14915	13345	28260	2100	600-45000	525-40000	1710	4000	45000
	329	PC-L	2	10	Wr	TJ37A1	2	N	.....	1640	.....	53.7′	56.8′	20.5′	523.0	24.4	15139	13681	28820	2100	600-45000	525-40000	1710	4000	45000
Mooney	20A	P-L	1	3	Lyco	O-360-A	1	180-2700	N	49	.....	.....	.....	.....	167.0	11.1	1480	970	2450	120	190-SL	180-7500	1075	1150	20000
Morrisey	2150	P-L	1	1	Lyco	O-320-A2A	1	150-2700	N	35	2	30.0′	21.3′	7.0′	144.0	.....	1125	692	1817	468	148-700	135-700	525	1450	22000†
North American	T-39	ET-L	2	4-8	.....	.....	2	.....	.....	850	.....	42.4′	43.8′	16.4′	334.0	.....	8153	.....	15330	.....	.....	500-41000	1400	.....	.....
Piper	PA-18-95	P-L	1	1	Cont	C-90	1	90-2475	N	18	1¼	35.3′	22.4′	6.7′	178.5	18.8	800	700	1500	400	112-SL	100-SL	380	710	15750
	PA-18-150	P-L	1	1	Lyco	O-320	1	150-2700	N	36	2	35.3′	22.5′	6.6′	178.5	18.8	930	740	1750	505	128-SL	113-SL	500	1050	20500
	Caribbean	P-LS	1	3	Lyco	O-320	1	150-2700	N	36	2	29.3′	20.5′	8.4′	147.5	13.2	1100	900	2000	485	139-SL	132-7000	570	620	15000
	PA-18-150	AU-L	1	N	Lyco	O-320	1	150-2700	N	36	2	35.3′	22.5′	6.6′	178.5	18.8	1060	1060	2070	1010	105-SL	90-SL	360	760	17000
	PA-22-160	P-LS	1	4	Lyco	O-320B	1	160-2700	N	36	2	29.4′	20.7′	8.4′	147.5	13.2	1110	890	2000	482	141-SL	134-7000	536	800	16500
	PA-23	P-L	1	4-5	Lyco	O-320B	2	320-2700	N	72	4	37.0′	27.2′	9.5′	204.0	16.7	2230	1570	3800	936	183-SL	171-7000	940	1260	17000
	PA-24	P-L	1	4	Lyco	O-360-A1A	1	180-2700	N	50	2	36.0′	24.8′	7.4′	178.0	14.1	1475	1075	2550	760	167-SL	160-8000	1100	910	18500
	PA-24	P-L	1	4	Lyco	O-540-A1A5	1	250-2575	N	60	3	36.0′	24.9′	7.4′	178.0	14.1	1600	1200	2800	646	190-SL	181-7000	1100	1400	20000
	PA-23-250	PC-L	1	4	Lyco	O-540	2	500-2575	N	144	6	37.0′	27.8′	10.4′	207.0	16.7	2775	2025	4800	950	215-SL	205-7000	1025	1650	22500
	PA-25	A-L	1	N	Lyco	O-320	1	150-2700	N	40	2	36.3′	24.0′	6.8′	183.0	9.4	1200	1100	2300	665	100-SL	90-7500	400	510	10000
Stits	SA-9A	T-L	1	1	Cont	C90-12	1	95-2625	N	24	1¼	28.4′	18.6′	6.5′	125.0	6.0	696	554	1250	230	150-10000	135-10000	540	900	16000
Transland	Ag-2	AF-L	1	1	PW	R-1340	1	600-2250	N	125	10	42.0′	28.4′	9.7′	321.0	44.8	3608	4092	7700	3547	141-SL	126-SL	570	950	16000
Trecker	L2	PC-LS	1	5	Lyco	GSO-480-A1A6	2	680-.....	N	.....	.....	44.4′	35.5′	13.0′	.....	.....	.....	4630	6614	.....	208-11000	179-10000	994	1279	25400
	166	P-L	2	6-8	Lyco	GSO-480-B1C6	2	680-3400	N	233	1	46.8′	38.1′	16.4′	285.9	21.3	5104	2998	8100	1020	228-11000	203-12800	1155	1305	27500
BELGIUM																										
Avions Fairey	Tipsy T-66 Mk. 1	P-L	1	N	Hepu	KFM 40-3500	1	40-3500	N	9	1	19.8′	14.8′	5.3′	80.5	9.0	384	278	662	.....	96-.....	87-.....	244	490	9000
	Tipsy T-66 Mk. 2	P-L	1	N	Stamo	1400	1	45-3200	N	9	1	19.8′	15.0′	5.3′	80.5	9.0	415	247	662	.....	100-.....	90-.....	220	600	12000
CANADA																										
Canadair	CL-66A	P	3	48-58	Nap	Eland	2	7000-12500	N	2032	5½	105.4′	79.2′	28.2′	920.0	44.0	34014	19186	53200	12988	340-20000	325-20000	2070	1800	20000†
	CL-44D-4	PC-L	7	172-189	RR	Tyne 12	4	22920-15250	N	12190	14¾	142.4′	136.7′	38.6′	2075.0	140.4	89800	115200	205000	65200	444-21200	403-20000	6275	1190	30000
de Havilland	DHC-2	PC-LS	1	6-7	PW	R-985-AN6B	1	450-2300	N	95	6¼	48.0′	30.4′	9.0′	250.0	24.6	2960	2140	5100	1722	163-5000	143-5000	650	1020	18000
	DHC-3	PC-LS	1	10-14	PW	R-1340-S1H1-G	1	600-2250	N	216	10¾	58.0′	41.8′	12.6′	375.0	26.3	4371	3629	8000	2937	180-5000	139-5000	1003	1000	19000
FRANCE																										
Breguet	765	PC-L	.....	126-164	PW	R-2800-CB16, 17	4	.....	N	.....	.....	149.3′	95.4′	33.4′	.....	.....	.....	.....	121030	37500	.....	250-.....	2500	.....	.....
	941	PC-L	2	40-48	DH	Gnome	4	5000-.....	N	1930	.....	76.1′	70.5′	29.0′	890.0	.....	22500	20900	44000	15000	270-3000	250†-3000	1350	.....	23000
	940	PC-L	.....	21	Tur	Turmo II	4	1600-.....	N	.....	.....	58.4′	40.0′	.....	.....	.....	.....	.....	14300	.....	.....	240-.....	.....	.....	.....
Dassault	MD-410	P-L	2	10	Tur	Bastan	2	1500-.....	340-.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11000	.....	.....	311-.....	1510	.....	.....
	MD-415	PE-L	2	8-10	Tur	Bastan	2	1500-33500	340-33500	.....	.....	53.9′	42.8′	14.2′	388.0	.....	79600	.....	11000	22050	.....	311-19700	1510	820	36100
Holste	MH-1521	PC-L	.....	6-8	PW	R-985	1	450-.....	N	.....	.....	45.1′	28.3′	.....	273.4	.....	3373	.....	5952	1655	168-.....	162-.....	746	1032	18095
	MH-260	PC-L	.....	20-23	Tur	Bastan	2	1500-.....	N	.....	.....	71.7′	57.8′	21.0′	586.6	.....	9735	.....	16975	.....	230-.....	217-.....	621	1378	.....
	MH-270	PC-L	.....	20-23	ArS	P-182	2	.....	N	.....	.....	71.7′	57.8′	21.0′	586.6	.....	9735	.....	16975	.....	230-.....	217-.....	621	1378	.....
	MH-280	PC-L	.....	20-23	Lyco	T-53	2	1500-.....	N	.....	.....	71.7′	57.8′	21.0′	586.6	.....	9735	.....	16975	.....	230-.....	217-.....	621	1378	.....
Hurel Dubois	HD-321	PC-L	.....	48	Wr	.....	2	3000-.....	N	.....	.....	148.0′	76.0′	27.2′	.....	.....	.....	.....	14000	.....	177-.....	.....	155	.....	.....
	HD-34	SP-L	.....	.....	.....	.....	2	.....	N	.....	.....	148.0′	76.0′	27.2′	.....	.....	.....	.....	.....	5740	.....	174-.....	500	.....	23000
	HD-332	C-L	.....	.....	Br	Hercules	2	4140-.....	N	.....	.....	148.0′	76.0′	27.2′	.....	.....	.....	.....	.....	13000	.....	127-.....	300	.....	.....
	HD-37	C-L	.....	.....	Br	Hercules	2	4140-.....	N	.....	.....	148.0′	76.0′	27.2′	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	HD-37	C-L	.....	.....	RR	Dart Mk. 527	2	.....	N	.....	.....	148.0′	76.0′	27.2′	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Morane-Saulnier	MS-760	P-L	1	3	Tur	Marbore II	2	N	1764-.....	370	.....	33.3′	33.4′	6.7′	193.8	.....	3164	.....	6283	.....	.....	342-9843	808	.....	.....
	880	P-L	1	2	Cont	C-90-14F	1	95-2625	N	22	1	20.4′	28.7′	8.5′	110.0	13.0	960	650	1610	.....	127-1640	115-1640	340	600	.....
Nord	N-2502	PC-L	3	45	Br[2]	Hercules 758, 9	4	4080-2800	.....	1344	70½	110.3′	72.1′	19.9′	1089.3	85.7	30090	21215	50700	16640	268-5000	191-5000	1710	1240	20700
	2508	PC-L	3	45	PW[2]	R-2800-CB17	4	5000-2800	1760-22600	1375	70½	110.3′	72.1′	19.9′	1089.3	85.7	30980	19720	50700	15660	270-5000	198-10000	1790	1535	26900
Sud-Aviation	SE-210	PC-L	2-3	64-80	RR	Avon RA-522	2	N	23400-.....	4900	.....	112.5′	104.8′	28.5′	1579.0	.....	57970	41260	99210	18300	.....	495-39370	1570	2460	.....
	SE-118	PE-L	2	4-12	Tur	Bastan	2	1500-.....	N	.....	.....	58.9′	44.4′	20.2′	450.7	.....	9920	.....	15340	.....	.....	320-19700	1250	.....	31650
GREAT BRITAIN																										
Armstrong-Whitworth	AW-650	PC	3	83	RR	Dart RDa7/2	4	7640-15000	N	3960	4	115.0′	86.8′	27.0′	1458.0	88.0	45350	.....	82000	27000	300-25000	298-22600	3000	1200	22600
AVRD	748 Series 1	PC-L	3	40-44	RR	Dart RDa6 Mk. 514	2	3200-14500	740-14500	1320	3¾	95.0′	67.0′	24.8′	795.0	42.4	18794	13555	33000	9666	294-20000	265-20000	951	1300	30000
	748 Series 2	PC-L	3	40-44	RR	Dart RDa7	2	3825-15000	1010-15000	1320	4	95.0′	67.0′	24.8′	795.0	42.4	19694	15656	36000	9666	314-20000	290-25000	1489	1620	30000
Blackburn	Universal	PC-L	2-4	200†	Br	Centaurus 873	4	12000-2800	N	4300	140	162.0′	99.4′	38.8′	2916.0	168.0	81740	61260	143000	50000	242-3600	230-6000	1730	760	15750
Bristol	300	P-L	7	149	B-S	Proteus 765	4	17800-11650	N	10330	43	142.4′	124.4′	38.7′	2075.0	140.0	94900	90100	185000	38100	403-22000	397-22000	4640	1720	32000
	310	P-L	9	149	B-S	Proteus 765	4	17800-11650	N	10330	43	142.4′	124.4′	38.7′	2075.0	140.0	93100	91500	185000	34900	409-22000	397-22000	4640	1500	31000
	175/320	P-L	9	149	B-S	Proteus 765	4	17800-11650	N	10330	43	142.4′	124.3′	38.7′	2075.0	140.0	93631	91369	185000	34369	409-24000	397-22000	5290	1750	29000

U.S. AND FOREIGN CIVIL AIRCRAFT—*concluded*

MAKE AND MODEL	Type	Number of Crew	Number of Seated Passengers	ENGINE: Make and Model	ENGINE: Number Used	ENGINE: Total Take-off Hp. at Specified RPM	ENGINE: Total Take-off Thrust at Specified RPM	Fuel Capacity (Gal.)	Oil Capacity (Gal.)	DIMENSIONS (Ft. & In.): Span	Overall Length	Height (Taxi Position)	Wing Area (Gross) Sq. Ft.	Aileron Area (Sq. Ft.)	WEIGHTS (Lb.): Empty	Useful Load	Gross	Pay Load	PERFORMANCE: Maximum Speed at Altitude	Cruising Speed at Altitude	Range in Miles at Cruising Speed	Initial Climb (Ft. per Min.)	Service Ceiling with Normal Load (Ft.)
GREAT BRITAIN—*continued*																							
de Havilland.....Heron Series 2	PE-L	1-2	8-17	DH..Gypsy Queen 30 Mk. 2	4	1000-2500	N	495	18½	71.5′	48.5′	15.6′	499.0	.....	8284	.....	13500	3223	.....	183-8000	680	930	18000
.....Comet 2	P-L	4	44	RR.....Avon	4	N	29400-.....	8408	.....	115.0′	96.0′	28.4′	2036.0	.....	.....	.....	120000	13000	.....	480-40000	2300	.....	.....
.....Dove Series 5 & 6	PE-L	1-2	6-11	DH..Gypsy Queen 70 Mk. 2	2	760-3000	N	202	11¼	57.0′	39.3′	13.4′	335.0	.....	5678	.....	8800	1703	.....	179-8000	565	920	20000
.....Comet 4 DH-106	P-L	4	58-78	RR.....Avon RA-29	4	N	42000-.....	10840	42	115.0′	111.6′	29.5′	2121.0	120.0	.....	.....	162000	20300	.....	500-40000	3225	3000	36000
.....Comet 4B	P-L	3-5	84	RR.....Avon RA-29	4	N	42000-8000	9500	42	108.0′	118.0′	29.5′	2059.0	121.0	75000	.....	156000	24600	.....	532-23500	2570	3000	23500
.....Comet 4C	P-L	3-5	84-99	RR.....Avon RA-29	4	N	42000-.....	10840	42	115.0′	118.0′	29.5′	2121.0	120.0	75000	.....	162000	24600	.....	510-33000	2820	3000	35000
.....DH-121	PC-L	3	79-97	RR.....RB-163	3	N	30300-.....	4610	.....	89.8′	114.8′	27.5′	1350.0	.....	.....	.....	105000	21500	606-25000	606-25000	1000	.....	.....
Handley-Page.....HPR-7	PC-L	2	36-47	RR.....Dart RDa7-527	2	3820-.....	1004-.....	1205	7¼	94.8′	71.9′	23.4′	886.0	59.4	21422	13300	39000	13300	288-20000	278-17400	1430	2000	29500
Hunting.....President	PCS-L	1-2	8-12	Av.....Leonides 514	2	1100-3000	N	286	16¾	64.5′	46.4′	16.1′	400.0	50.2	.....	.....	13500	.....	220-1800	167-8000	1110	.....	24000
.....Provost	T-L	2	N	Av.....Leonides Mk. 2500	1	550-.....	N	72	6	35.2′	29.0′	8.8′	.....	.....	.....	.....	4250	.....	200-2500	177-11500	633	2100	22500
Jackaroo.....Mk. I	P	1	3	DH.....Gypsy Major 1	1	120-.....	N	20	2	30.0′	25.3′	8.8′	247.0	22.4	1399	456	2180	456	105-1000	85-1000	240	500	10000
.....Mk. II	Agr	2	N	DH.....Gypsy Major 1	1	120-.....	N	20	2	30.0′	25.3′	8.8′	247.0	22.4	1399	456	2180	456	105-1000	70-.....	240	430	10000
Lancashire.....EP-9	PCA-L	1	3	Lyco.....GO-480-G1A6	1	295-.....	N	67½	3	43.5′	29.8′	8.8′	227.6	22.8	2174	1789	4320	2146	144-SL	118-SL	500	600	9000
.....EP-9	PC-L	1	5	Lyco.....GO-480-G1A6	1	295-.....	N	67½	3	43.5′	29.8′	8.8′	227.6	22.8	2072	1082	3200	1628	146-SL	120-SL	510	960	12500
Rollason.....D-31	P-L	1	N	Ardem.....4CO2	1	31-3000	N	8½	½	21.0′	17.4′	5.0′	77.5	.....	350	.....	602	218	88-.....	75-.....	345	700	.....
Scottish Aviation.....Pioneer	PC-L	1	4	Av.....Leonides 503/7	1	540-3000	N	145	12	49.6′	34.4′	10.3′	390.0	15.0	4200	1600	5800	1015	145-1500	114-5000	585	720	16000
.....Twin Pioneer	PC-L	1	16	Av.....Leonides 514/8A	2	1080-3000	N	298	21¾	76.8′	45.3′	12.3′	670.0	25.4	9960	4000	14000	2900	165-1500	125-5000	635	1170	17300
.....Twin Pioneer	PC-L	1	16	PW.....1340-S3H1-G	2	1200-2250	N	298	21¾	76.5′	45.3′	12.3′	670.0	25.4	10870	3200	14600	2600	163-3000	125-5000	635	884	15000
.....Twin Pioneer	PC-L	1	16	Av.....Leonides 531/8B	2	1230-3200	N	298	21¾	76.5′	45.3′	12.3′	670.0	25.4	10170	4300	14600	3120	162-2000	131-5000	635	1270	20000
.....Twin Pioneer	PC-L	1	16	Av.....Leonides 532/8	2	1230-3200	N	298	21¾	76.5′	45.3′	12.3′	670.0	25.4	10170	4300	14600	3120	167-4200	134-5000	635	1260	20500
Vickers-Armstrongs.....700-D	PC-L	2	40-59	RR.....Dart 510	4	6400-14500	N	2360	19½	94.0′	81.8′	26.8′	963.0	94.8	37070	26000	64500	12000	331-20000	320-20000	2120	1500	30000
.....810	PC-L	2	52-70	RR.....Dart 525	4	7200-15000	N	2282	19½	94.0′	85.7′	26.8′	963.0	94.8	41565	29215	72500	14700	366-20000	356-20000	1890	1900	30000
.....840	P-L	2	52-70	RR.....Dart 541	4	8400-15000	N	2282	19½	94.0′	85.7′	26.8′	963.0	94.8	42540	28240	72500	13700	410-20000	394-20000	1730	2150	30000
.....950	PC-L	2-3	82-139	RR.....Tyne 11	4	20120-15250	N	6125	27½	118.0′	122.8′	34.9′	1529.0	122.0	80314	56646	141000	29000	445-20000	438-20000	3360	2350	30000
.....790	P	2	54-65	RR.....Dart 506	4	5600-14500	N	2282	19½	94.0′	81.8′	26.8′	963.0	94.8	37280	23220	61500	11542	317-20000	300-20000	1725	1250	25000
.....VC-10	P	5	88-150	RR.....Conway	4	N	.....	.....	.....	140.0′	158.8′	39.2′	2800.0	.....	.....	.....	299000	38000	.....	600-30000	.....	.....	.....
ITALY																							
Aer Macchi.....MB-308	P-L	1	1	Cont.....C-85	1	85-2575	N	21	1	32.8′	21.4′	7.2′	147.6	11.8	902	528	1430	528	106-SL	89-SL	470	630	14250
.....MB-308	P-L	1	1	Cont.....C-90	1	90-2475	N	21	1	32.8′	21.4′	7.2′	147.6	11.8	902	528	1430	528	110-SL	92-SL	445	.....	.....
.....MB-308-1	P-S	1	1	Cont.....C-90	1	90-2475	N	21	1	32.8′	21.8′	8.8′	147.6	11.8	1035	484	1519	484	105-SL	89-SL	435	.....	.....
.....MB-308-G	P-L	1	2	Cont.....C-90	1	90-2475	N	23¾	1	32.8′	21.4′	7.2′	147.6	11.8	946	638	1584	638	108-SL	90-SL	335	.....	.....
.....MB-320	PC-L	1	5	Cont.....E-185	2	410-2600	N	93	8	42.7′	28.4′	10.5′	227.1	16.2	3652	904	5500	944	162-SL	136-6500	810	925	14750
.....MB-320	PC-L	1	5	Cont.....E-225	2	450-2600	N	93	8	42.7′	28.4′	10.5′	227.1	16.2	3652	904	5500	944	169-SL	143-6500	760	1220	17900
Nardi.....FN-333	P-LS	1	1-3	Cont.....O-470-H	1	240-2600	N	53	3	34.1′	23′11½″	10.0′	161.4	10.7	2028	948	2976	660	180-SL	166-8000	664	1279	18000
Piaggio.....P-136-L-1	PC-LS	1	4	Lyco.....GO-480-B	2	540-3400	N	190	6	44.4′	35.5′	12.6′	270.0	25.0	4400	1600	6000	935	184-SL	182-8000	990	1180	18500
.....P-136-L-2	PC-LS	1	4	Lyco.....GSO-480-A1A	2	680-3400	N	190	7½	44.4′	35.5′	12.6′	270.0	25.0	4670	1944	6614	935	210-12000	190-13500	935	1260	25500
.....P-149-D	PC-L	1	3-4	Lyco.....GO-480-B	1	270-3400	N	63	3	36.5′	28.2′	9.6′	203.0	16.4	2550	1150	3700	700	190-SL	165-7500	620	1100	16500
.....P-166	PC-L	1-2	6-7	Lyco.....GSO-480-B1C6	2	680-3400	N	222	8½	46.8′	38.1′	16.4′	285.9	21.3	5070	3045	8115	1498	224-11000	184-15000	1155	1305	27500
SPAIN																							
A.I.S.A.....1-11B	P-L	2	N	Cont.....C-90	1	95-2625	N	17½	1½	30.6′	21.3′	6.3′	143.8	14.9	9300	.....	14800	.....	117-SL	106-SL	378	698	14900
C.A.S.A.....201	P-L	3	10	Av.Leonides 503/7 Mk. 127	2	1080-3000	N	317	20	60.4′	45.3′	13.0′	450.0	.....	8600	3530	12125	1970	221-7200	190-9850	1305	1085	25600
.....202	P-L	3	14	En.....Beta B-4	2	1550-2200	N	565	25	70.8′	52.5′	19.9′	618.0	.....	11570	6500	18080	2840	230-9300	205-9843	1087	1025	24000
.....207	P-L	4	30	Br.....Hercules 730	2	4080-2800	N	945	36¼	91.2′	68.4′	22.4′	924.0	.....	21660	12840	34500	6420	285-6000	236-6550	2425	1320	28200
.....202-B	PE-L	2	6-8	Wr.....R-1820-56	2	2600-2600	N	862	41¼	67.5′	53.7′	20.8′	603.0	37.2	13385	7885	21270	3088	268-2500	230-12000	1700	1810	24950

ABBREVIATIONS

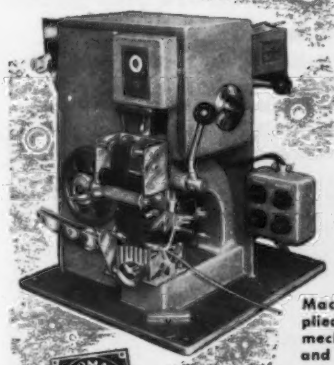
2—Also two Turbomeca Marbore engines.
AF-L—Agriculture or forestry; land.
Agr—Agriculture.
A-L—Agriculture; land.
All—Allison, Div.
ArS—Armstrong-Siddeley Motors, Ltd.
AU-L—Agriculture or utility; land.
Av—Alvis, Ltd.
Br—Bristol Aeroplane Co.
B-S—Bristol-Siddeley.
C-L—Cargo; land.
Cont—Continental Motors Corp.
DH—deHavilland Aircraft Co., Ltd.
DS-L—Duster or sprayer; land.
En—Enmasa.
ET-L—Executive transport; land.
ET-LS—Executive transport; land or sea.
Fair—Fairchild Engine and Airplane Corp.
GE—General Electric Co.
Kie—Kiekhaefer Corp.
Lyco—Lycoming Div.
N—None.
Nap—Napier.
P—Passenger.
PC—Passenger or cargo.
PCA-L—Passenger, cargo or agriculture; land.
PC-L—Passenger or cargo; land.
PC-LS—Passenger or cargo; land or sea.
PCS-L—Passenger, cargo or survey; land.
PE-L—Passenger or executive; land.
P-L—Passenger; land.
P-LS—Passenger; land or sea.
P-S—Passenger; sea.
PW—Pratt and Whitney Aircraft Div.
RR—Rolls Royce, Ltd.
SL—Sea level.
SP-L—Survey or photographic; land.
T-L—Trainer; land.
Tur—Turbomeca.
Wr—Wright Aeronautical Div.

Automark

MOTOR DRIVEN
or HAND OPERATED

WIRE AND TUBE MARKERS

WITH SPEEDS UP TO 17,000 FEET PER HOUR



Equipped with 110 V AC Motor.

Adjustable stamping depth.

Foil feed adjustable and automatic.

Feed adjustment 1" to 18"

Accommodates wire size AN-26 thru AN-0000, and tubing from 1/16" to 1-1/2" O. D.

Heat range from 100° F. to 600° F. controlled by thermostat and thermometer.

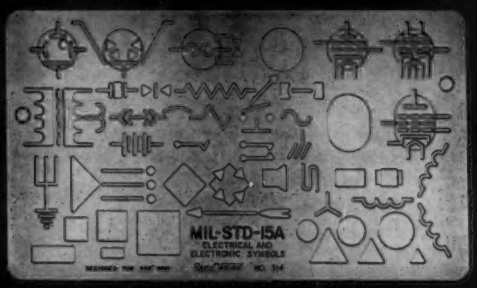
Machine can also be supplied with automatic cut-off mechanism, bench mounting and foot pedal operation.

AUTOMARK SAVES TIME

DEFIANCE
MACHINE & TOOL COMPANY
1920 S. VANDEVENTER Dept. AM ST. LOUIS 10, MO.

Circle 53 on Inquiry Card

MIL STD 15-A TEMPLATE



NO. 314 — 7" x 4" — .200 GRID
NO. 315 — 8¾" x 5" — .250 GRID

$4.00 AT YOUR LOCAL DEALER

Two of the more than 100 Rapidesign Templates—all of which are better made and more useful and lesser priced.

CATALOGUE NO. 60 AVAILABLE UPON REQUEST

RAPIDESIGN INC.
P. O. BOX 429, BURBANK, CALIFORNIA

Circle 54 on Inquiry Card

B & P Precision Cabinets and Consoles for Missile System Ground Support Equipment

Cabinets and consoles for electronic and fire control equipment are important elements of ground support equipment in every missile and radar system.

For many years B & P has made cabinets for Nike and other missile systems. These precision cabinets, of magnesium or aluminum, are made as arc-welded assemblies. Special techniques have been developed to prevent distortion during welding. Every cabinet is stress-relieved after welding.

Of the thousands of cabinets and consoles built by B & P, all have been held to close dimensional precision.

When you need lightweight electronic cabinets and consoles, think first of B & P, the most experienced builder of precision light metal electronic ground support equipment cabinets. For more complete details, write to B & P, Detroit.

60-T-10

BROOKS & PERKINS, INC.
1904 W. Fort Street • Detroit 16, Michigan
Offices in Washington and New York

Circle 55 on Inquiry Card

FREE LITERATURE

Worth Asking For

Space Films

A 12-page bulletin, designated PIB-38, describes the space photography project resulting in first films of earth from space. *General Electric, MSVD*

Circle 100 on postcard for more data

Heat Treating Steel

Technical booklet entitled, "Modern Principles of Heat Treatment of Steel." *Uddeholm Co. of America.*

Circle 101 on postcard for more data

Explosive Ordnance

Technical data book on firm's explosive ordnance products and devices. *McCormick Selph Associates.*

Circle 102 on postcard for more data

Sensing Elements

Bulletin describes new way of mounting sensing elements for use with flame-spray system of applying pure oxide refractory coatings to metals. *Norton Company*

Circle 103 on postcard for more data

Pin Plugs

Engineering data on pin-plug line. *The Lee Co.*

Circle 104 on postcard for more data

Space Vehicle Design

Booklet gives 24 pages of physical data on solar system; provides information for computing missile trajectories. *General Electric, MSVD*

Circle 105 on postcard for more data

Vacuum Induction Melting

Illustrated description of vacuum induction process and superalloys. Includes charts. *Metals Div., Kelsey-Hayes Co.*

Circle 106 on postcard for more data

Thermal Insulation

Portfolio of data on new "Fiberite" compression molded high-temp insulation materials. *The Fiberite Corp.*

Circle 107 on postcard for more data

Jigs and Fixtures

Catalog of jig and fixture "Everyday Standards" includes removable tracing templets. Available to those in tooling programs. *Standard Parts Co.*

Circle 108 on postcard for more data

Automatic Test Equipment

"SCATE" system pictorially described. *Stromberg-Carlson.*

Circle 109 on postcard for more data

Zirconium

Fact file. *The Zirconium Asso.*

Circle 110 on postcard for more data

Nuclear Instrumentation

Catalog I-60, 36 pages on radiation detection and measuring equipment. *Nuclear Measurements Corp.*

Circle 111 on postcard for more data

Measuring Tools

96-page catalog gives complete line of measuring tools. *Scherr-Tumico.*

Circle 112 on postcard for more data

Oxygen

Data, handling units. *Liquid Carbonic Div., General Dynamics.*

Circle 113 on postcard for more data

Hydrogen Peroxide

Chart shows propellant combinations using H_2O_2. *Becco Chemical Div.*

Circle 114 on postcard for more data

Muti-Flo Reforming

Detailed literature on the new "Multi-Flo-Reforming" process. *Lodge & Shipley.*

Circle 115 on postcard for more data

Metal Crystals

Eleven-page bulletin No. 102 on large single metal crystals. *Flow Corp.*

Circle 116 on postcard for more data

CF700-1

Bulletin GED-3986 describes design, performance of CF700-1 small aft fan engine. *General Electric Co.*

Circle 117 on postcard for more data

Pulse Transformers

Catalog includes history, applications of low level pulse transformers. *PCA Electronics.*

Circle 118 on postcard for more data

Protective Enclosures

32-page catalog describes complete line of hermetically sealed and protective enclosures for relays, switches, and control packages. *Automatic Electric Co.*

Circle 119 on postcard for more data

Data-Collection

Data-collecting system for industry described. *Friden Inc.*

Circle 120 on postcard for more data

Cavity Sinker

Brochure describes Model HCS-59 sinker. *Anocut Engineering Co.*

Circle 121 on postcard for more data

Cincinnati Milling

Color-brochure on firm's work. *The Cincinnati Milling Machine Co.*

Circle 122 on postcard for more data

Servo Motors

Full data on line. *Avionic Div., John Oster Mfg. Co.*

Circle 123 on postcard for more data

Numerical Controls

Guide book of numerically-controlled machine tools contains basic information and approximate costs of getting into tape-controlled operations. *Ex-Cell-O Corp.*

Circle 124 on postcard for more data

Tracer Control Systems

Bulletin describes hydraulic tracer control systems for one, two, and three dimensional applications on machine tools. *True-Trace Corp.*

Circle 125 on postcard for more data

Aircraft Bolts

Bulletin shows line of high-strength aircraft bolts which provide 220,000 psi minimum tensile strength and reduce fastener weight. *Aircraft and Missiles Div., Standard Pressed Steel Co.*

Circle 126 on postcard for more data

Micro-Drilling

22-page manual problem, techniques and equipment for micro-drilling holes from .001 in. to .020 in. diameter. *The Dumore Co.*

Circle 127 on postcard for more data

Chem-Mill

Chem-mill process for contouring honeycomb described. *Chem-mill, Div. of Turco Products.*

Circle 128 on postcard for more data

Aluminum Casting Alloy

Design and foundry information on TENS-50 alloy. *Navan Products*

Circle 129 on postcard for more data

Tubing Process

Brief explanation of "Rockrite" process which compression-forms tubing stock. *Tube Reducing Corp.*

Circle 130 on postcard for more data

Solenoid Valves

Diagrams of Floating Seal valves. *Valcor Engineering Corp.*

Circle 131 on postcard for more data

◆

New for Production

Honing Mandrels

Line of honing mandrels has been expanded to cover ID's as small as .100 in. Supplied in short hole and long hole designs.— Sunnen Products Co.

Circle 134 on postcard for more data

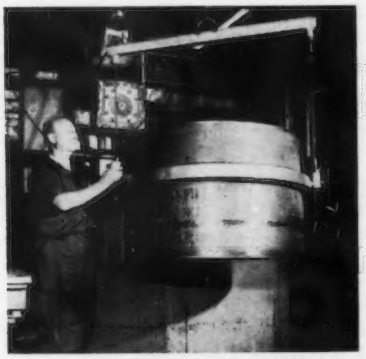
Glow Lamps

Extra brilliant lamps were developed for high ambient light application. Called the LNE line, they operate at ½ watt on 105-125 volts A.C.—Signalite Inc.

Circle 135 on postcard for more data

Materials Handling

Specialized pneumatically-operated grabs apply an even peripheral pressure against the load.



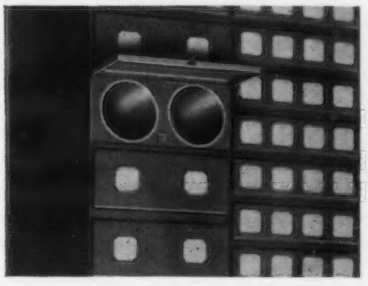
Specially designed neoprene pneumatic members are assembled in annular metal channel retainers. Controlled air pressure is introduced into the pneumatic chamber. This expands the unsupported face of the pneumatic member equally against the load. Equipment is being used with large and delicate missile cylinders.—The Presray Corp.

Circle 132 on postcard for more data

Roll File

Inside diameter of new roll file unit has been increased to 4-⅞ in. File has a furniture steel housing for four duro-tubes. It is available in seven sizes measuring from 2 to 5 ft long. Can be stacked with basic 2-⅝ in. file units. — Plan Hold Corp.

Circle 133 on postcard for more data

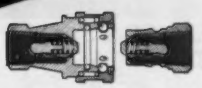


Hydraulic and pneumatic lines are quickly and easily connected with Hansen Two-Way Shut-Off Couplings. No tools required.

When Coupling is disconnected, valves contact valve seats in both Socket and Plug to provide instant and positive seal of fluid in both ends of line. Coupling does not depend upon line pressure to seal either end of line.

Six sizes are available, with female pipe thread connections from ⅛" to 1" respectively. Furnished either in steel or brass.

Representatives in Principal Cities ... See Yellow Pages



Instantly shuts off both sides of line... prevents loss of liquid, gas or pressure.

Quick-Connective Fluid Line Couplings for

COMPRESSED AIR • OIL
GREASE • HYDRAULIC FLUIDS
WATER • VACUUM • STEAM
OXYGEN • ACETYLENE
REFRIGERANTS • GASOLINE
COOLANTS • LP-GAS

Write for the Hansen Catalog

Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.

SINCE 1915 — QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 35, OHIO

Circle 50 on Inquiry Card

New for Production

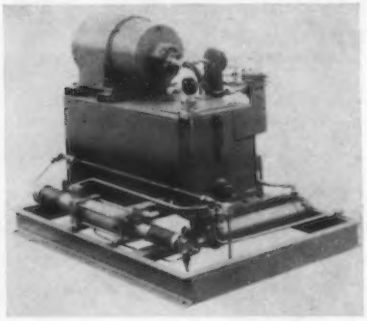
Air/Hydraulic Feeds

Hydraulic Feeds for punching, clamping, riveting, shearing or pressing metals or plastics are powered by a shop's own air supply. Self-contained units require no pumps or motors. Almost any sequence of operations may be performed automatically through the use of trigger valve actuators or solenoids.—Superior Controls

Circle 136 on postcard for more data

Booster Compressor

Model SS-2 consists of a hydraulically-driven booster compressor, hydraulic power unit and a



cycling control package, all integrally contained within a single frame structure. Furnished without gas system accessories for greater latitude in adapting unit to a particular plumbing set-up or other requirements. No oil or other conventional lubricants ever need be introduced into the gas system, virtually eliminating contamination.—Haskel Engineering & Supply Co.

Circle 137 on postcard for more data

Vacuum Furnace

High vacuum furnace makes hardness tests at temperatures up to 3000°F.

Heating element is a cylinder of sheet molybdenum 3 in. I.D. by 12-¾ in. long.—Marshall Products Co.

Circle 138 on postcard for more data

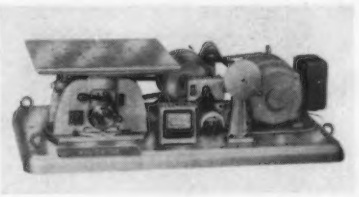
Precision Welder

Shielded-arc welder is designed for precision welding applications. Designated the VTW-14, it may be used with any available inert-gas, shielded-arc welding heads. Can also be used with manual or automatic machines. Handles both ferrous and non-ferrous alloys from approximately .001 to .025 in. thickness.—Hughes Aircraft.

Circle 139 on postrard for more data

Fatigue Testers

Improved vibration fatigue testing machine has vertical table movement controlled entirely by a piston-operated mechanism. Table load capacity: 150 lb. at 10 g acceleration. Maximum capacity is approximately 23 g. Acceleration and deceleration are regulated by



the Range Selector, an automatic frequency control device. — All American Tool & Mfg. Co.

Cirrle 140 on postcard for more data

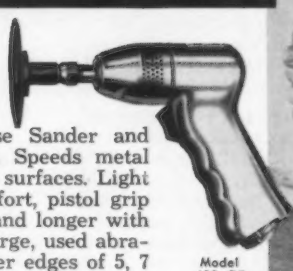
Hardness Tester

Motorized hardness tester automatically removes major testing loads. It is available as a combination tester which provides both regular and superficial Rockwell Hardness testing in a single machine. —Torsion Balance Co.

Cirlle 141 on postcard for more data

NEW AIRETOOL PNEUMATIC PRODUCTION TOOLS...

CUT COSTS AND STEP UP ASSEMBLY AND METAL FINISHING OPERATIONS



Model 400 GP

Model 400 GP General Purpose Sander and Grinder for fine metal finishing. Speeds metal sanding on both flat and contour surfaces. Light weight combined with hand comfort, pistol grip enables operator to work faster and longer with less fatigue. Permits salvage of large, used abrasive discs by trimming worn outer edges of 5, 7 and 9 inch to re-usable smaller discs.

Models 420 and 421

Models 420 and 421 Automatic Push-Start Screwdrivers and Nutsetters. Ideal for fabrication and assembly of all plastic, wood and metal components. Positive-acting automatic push-start feature is actuated upon contact with work piece and quickly and securely seats either screw or nut. Fast, easy conversion from screwdriver to nutsetter accelerates on-the-job changeovers.

Learn how the complete Airetool line of pneumatic production and maintenance tools can help you increase production while cutting costs. Contact your nearest representative or write today for free descriptive catalog.

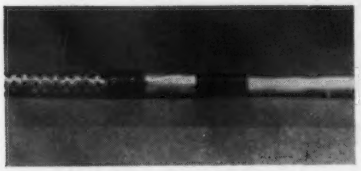
REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii
CANADIAN PLANT: 37 Spalding Drive, Brantford, Ontario
EUROPEAN PLANT: Vlaardingen, The Netherlands
BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD OHIO

New Materials

Hi-Temp Rocket Cable

A cable with extremely stable dielectric properties in rocket blast environments has been developed



with attendant high gas velocities. It is particularly suited for use in instrumentation bridge circuitry. Manufacturer advises that the cable can be custom-made in a wide variety of conductor sizes.—Pacific Automation Products.

Circle 142 on postcard for more data

Built-In Damping

High damping characteristics are built into new structural members for aerospace applications. The

damping is better than can be attained by the best current design practice. Reduction is accomplished without the use of vibration isolators. A new material process called Rigidamp is used.—Barry Controls Inc.

Circle 143 on postcard for more data

Low-Cost Foam

Rigid and flexible foams are being marketed under the name "ArcMold." The foams are the "one-shot" type, mixed and foamed on the spot, with no pre-cook polymers. Within one hour after mixing, the expanded foam attains 90 per cent of its life-time properties.

Densities from 1 lb to 40 lb/cu ft can be obtained. ArcMold Foams have better insulating qualities than cork from –65°F to the temperature of boiling water.—Atlantic Research Corp.

Circle 144 on postcard for more data

Silicone Gel

When catalyzed, silicon fluid (XF1-0042, Dow Corning) becomes soft transparent, and jelly-like. It has promise for encapsulation where parts must be examined being encased.—Dow Corning Co.

Circle 145 on postcard for more data

New BeO Ceramic

A BeO ceramic called Berlox EM is specially processed for vacuum tubes. It has all of the properties which have made beryllium oxide valuable in a wide variety of electronics applications. In addition, it is vacuum tight, free of outgassing, and has a surface especially well suited to metallizing. It is available with no cost premium in rods, tubes, cylinders, and bulk shapes. Can be ordered plain or machined to specifications.—National Beryllia Corp.

Circle 146 on postcard for more data

Aerosol Colors

Push-button color-coding — for production, maintenance and safety —is featured in a line of 47 aerosols.

Nineteen self-spraying colors are offered, plus two marking paints. The 16-oz push-button cans are quick, clean, and easy to use. They are used to mark conduits, spotlight moving parts, and identify emergency equipment.

The 19 enamels are also used for coding stock and materials and for identifying tools by department. —Sprayon Products Inc.

Circle 147 on postcard for more data

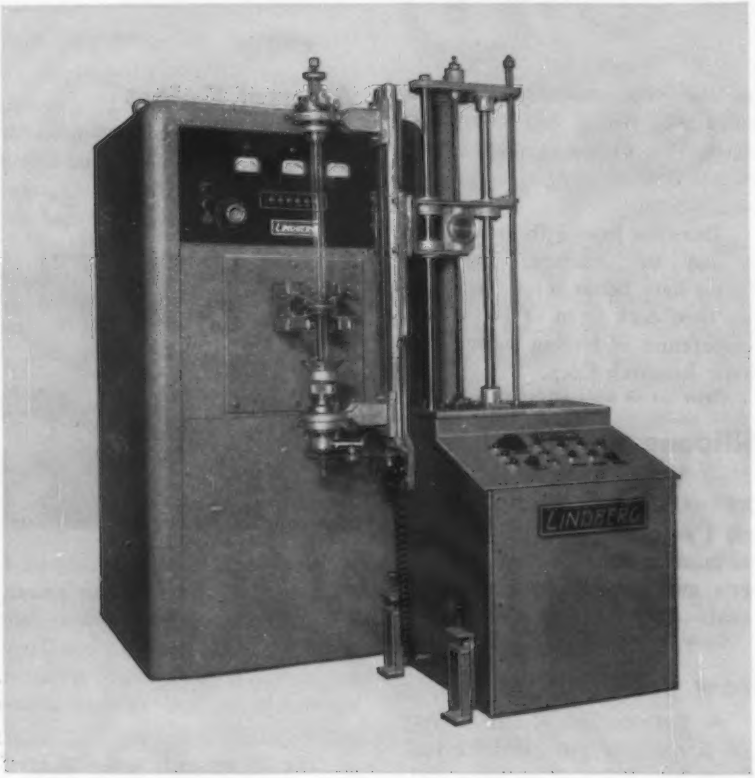
Phenolic Laminate

TRC-X, a high strength reinforced phenolic laminate withstands 1000°F without blistering or delaminating.

TRC-X was intended as a low-dielectric, structurally-strong material for nose cones of intermediate range missiles. Because of its strength at low temperatures, and because it is impervious to acids and alkalis, it has been adapted for use as missile wing, fin, and body insulation and for many other structural applications.—Riverside Plastics.

Circle 148 on postcard for more data

For research and more accurate production of hyperpure materials for semi-conductors—the new Lindberg Floating Zone Scanner



This newly developed Floating Zone Scanner is a product of Lindberg's technical staff, widely recognized for many significant developments in the application of heat to industry. Expertly designed, it provides more accurate and more precise production of semi-conductors as well as serving as ideal research equipment. Already, a number of important companies in the semi-conductor field are using this equipment for research and production. Lindberg Induction Heating Units have been specifically designed for use as research and production equipment for crystal growing and zone refining of semi-conductors and other materials. Write for our Bulletin No. 1600.

High Frequency Division
LINDBERG ENGINEERING COMPANY
2473 WEST HUBBARD STREET, CHICAGO 12, ILLINOIS
Los Angeles Plant: 11937 South Regentview Avenue, at Downey, California
In Canada: Birlefco—Lindberg, Ltd., Toronto

LINDBERG heat for industry

New Materials

All-Purpose Cleaner

Mild-neutral Plaudit is an all-purpose industrial cleaner. Manufacturer sees wipe-on, and ultrasonic applications in the aircraft-missile industry. Has been used for upholstery in aircraft interior, and cleaning of metal parts in production. It is simply mixed with water in varying concentrations.—Turco Products Inc.

Circle 149 on postcard for more data

Refractory Material

"Asbestosite," a new refractory material, is said to withstand continual exposure to temperatures in the 1000°F to 3000°F range. It also stands much higher temperature during intermittent periods. Tests recently concluded on cylindrical specimen parts with ½-in. wall thicknesses indicated a continuous OD temperature of 650°F. ID temperature readings were a continuous 2500°F.—Harco Laboratories.

Circle 150 on postcard for more data

Nickel Steels

Yield strengths exceeding 250,000 psi with elongation from 6 to 10 per cent are claimed for a new family of 25 per cent nickel steels. High-strength alloys, have good cold forming properties after annealing. They are weldable in hardened condition without preheating. Available in bar, plate, tube, and sheet. —International Nickel Co.

Circle 151 on postcard for more data

Checking Honeycomb

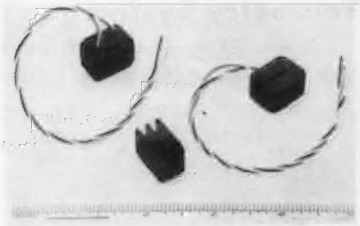
Bondcheck, a liquid spray, is applied to brazed honeycomb panels to check quality of the braze. After liquid is applied, part is put under

infrared lamps. Heat flows to bonded areas and honeycomb pattern appears where there is a bond. Voids appear as broken lines. Works best on skin thickness under 0.045 in. Pattern is easily photographed for permanent record. —Magnaflux Corp.

Circle 152 on postcard for more data

Rapid-Molding Epoxy

New epoxy molding compounds are hailed as a major breakthrough



for rapid mass production of computer and missile components. They are known as EMC. Soft-flow molding characteristics make the high-speed molding possible. EMC has reduced manufacturing costs to as low as one-sixth former outlays. Uses vary from molding of miniature electronic parts smaller than a paper clip to the manufacture of giant electrical transformers.—American-Marietta Co.

Circle 153 on postcard for more data

"Non-Melting" Lubricant

"Hot" bearings on production machinery may benefit from two new anti-friction compositions. Maker claims lubricants have no melting or dropping point. They have heavy molecular structure and high extreme-pressure valves. Known as Compositions 1 and 2, they come in 14½ oz cartridges for lever-gun application.—The Whitmore Mfg. Co.

Circle 154 on postcard for more data

For basic research, pilot plant studies and the more efficient production of semi-conductors—new Lindberg Diffusion Furnaces

Here is a new Lindberg Furnace designed specifically for basic research, pilot plant work, or production of solid state devices. It is offered in a variety of sizes and capacities to enable industries in the semi-conductor field to have higher powered equipment adequately insulated and designed for its specific use. With this type of furnace available, it is not necessary for industry to attempt to adapt ordinary furnaces to the highly specialized requirements of the semi-conductor field. For complete information on Lindberg's standard line of furnaces specifically designed for gaseous and solid diffusion uses write for our Bulletin No. T-1081.

Pilot Plant Equipment Division
LINDBERG ENGINEERING COMPANY
2473 WEST HUBBARD STREET, CHICAGO 12, ILLINOIS
Los Angeles Plant: 11937 South Regentview Avenue, at Downey, California
In Canada: Birlefco—Lindberg, Ltd., Toronto

LINDBERG heat for industry

Circle 60 on Inquiry Card

New Electronic Products

Radiation Detector

Solid state ionization chamber measures number and energy of high-speed atomic particles. The detector is a very thin slice of 'doped' silicon. When struck by a charged

nuclear particle it emits a pulse which can be measured and analyzed.

Future uses include measuring radiation in nuclear reactors, industrial process control, nuclear particle experimentation, space exploration.

Tube in illustration contains detector battery and amplifier. — Hughes Aircraft Co.

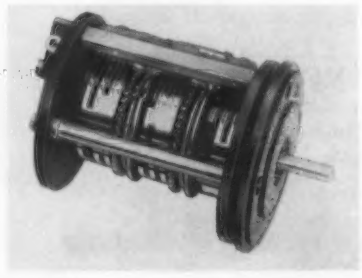
Circle 155 on postcard for more data

Switching Diodes

Fastest high-current silicon switching diode yet is now in volume production. It is used in computers.

Labelled "the 1N920-1N923 series" it has met the requirements of high-current pulse circuits for computer switching, pulse clamping, gating, blocking and diode logic circuits. The 0.3 microsec, ½-amp devices are available immediately in quantity. — Sperry Semiconductor Div., Sperry Rand Corp.

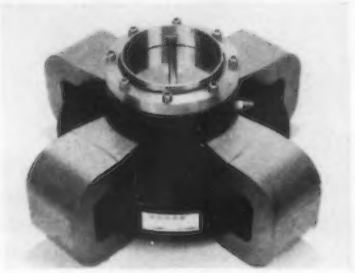
Circle 156 on postcard for more data



Electronic Pump

High - vacuum electronic pump handles 40 liters per sec. Operating on a cold-cathode discharge within a magnetic field, the unit has no moving parts. The modular internal structure is easily removed for maintenance and replacement.

Combined with an appropriate power supply, pump constitutes a complete high-vacuum system — no traps, baffles, nor water connections



required. A roughing vacuum of 15 to 20 microns is required only for starting. Weight 54 lb. Overall dimentions: 15¼-in. diam by 7⅜ in. high.—ULTEK Corp.

Circle 157 on postcard for more data

Compact Converter

A miniature analog to digital converter package can be integrated directly to size 15 transducers for use in airborne computers. The unit is used to represent angular shaft rotation by coded digital outputs to computer systems. The compact converter has 1.437 in. diam and is 1 15/16 in. long, including a half-inch shaft. Weight is 3.37 oz, including a housing and 18-in. wire leads. One hundred revolutions of the input shaft are required to complete the entire code from 0 to 999 or from –0 to –000.—Courter Products Div., Model Engineering and Manufacturing, Inc.

Circle 158 on postcard for more data

Telemetry System

A new 25-lb, ½-cubic ft pulse code modulation telemetry system

for missiles and space vehicles is designed entirely with solid - state devices. It may be used to drive any of the TI transmitters dictated by the particular application. The system multiplexes and encodes 64 analog channels, and processes five 8-bit parallel digital data channels plus a serial digital data channel at a nominal bit rate of 200 kc.—Texas Instruments Inc.

Circle 159 on postcard for more data

Silicon Mesa Transistor

Two newly - developed silicon mesa transistors are on the market.

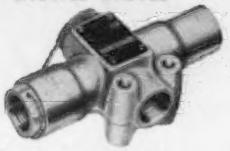
Either of the devices can replace up to three transistors of the same classification in many circuit applications. They are designed for use as high speed switching units operating at medium power levels and as very high frequency amplifiers.—Hoffman Electronics Corp.

Circle 160 on postcard for more data

RELIABILITY
AND
PERFORMANCE
are our main products

First, imaginative design; then experienced thoroughness through development, tooling, production, assembly and tests, all under strict quality control in an unusually well equipped plant . . . we can help you solve your special problems . . .

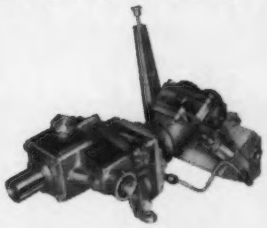
- SHUTTLE VALVES



- RELIEF VALVES

- SELECTOR VALVES

- COMPLEX PACKAGES



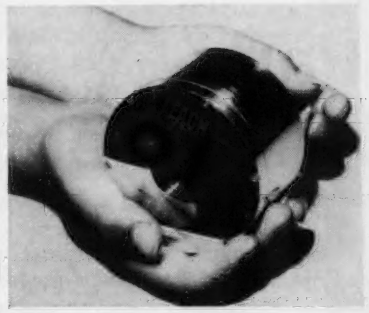
also

- SOLENOID VALVES
- TRANSFER VALVES
- BRAKE VALVES
- PRESSURE REDUCERS
- FUEL PUMPS
- DEHYDRATORS
- COMPACT COMPRESSORS

WRITE, wire, or phone for data, quotations and service.

M. C. MANUFACTURING CO.
LAKE ORION, MICHIGAN
PHONE: MYRTLE 3-3711

Circle 61 on Inquiry Card



Tiny Tape Recorder

Airborne tape recorder for missiles and satellites weighs only 10½ oz. It records on one to 16 channels on a continuous tape. Resistance to shock is over 2000 G's. Power consumption is extremely low at 1½ watts.—Leach Corp.

Circle 161 on postcard for more data

Transistorized Converter

Airborne analog-to-digital converter is one-half the size and weight of some previous converters. The 12-bit unipolar device is in production use on Project Tall Tom.

Transistorized for minimum size and maximum reliability, the unit performs a 12-bit conversion to an accuracy of ±1 millivolt in 65 micro sec over the temperature range of —55 to +70°C.

Called the M4, it is designed to meet MIL-E-5400B and MIL-E-005272. — Packard Bell Computer Corp.

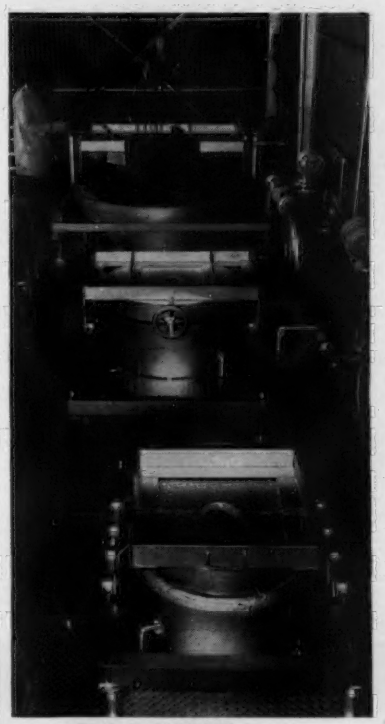
Circle 162 on postcard for more data

Temperature Control

A British firm has developed an accurate temperature controller rugged enough for general use. Immediate use is in the control of furnaces used for creep-testing alloy steels. It is claimed the new controller will maintain an accuracy of ±0.25°C at a temperature of 1000°C for months. First 56 instruments have been in continuous service for three years. The total 'down time' for the whole batch has been only three hours.—Winston Electronic Ltd.

Circle 163 on postcard for more data

from
the fiery
furnaces of
WESTERN ALLOY



BRAZING
at temperatures up to
2200° Fahrenheit

Abilities, experience and advanced methods in the use of dry hydrogen atmospheres for brazing make possible the efficient joining of aircraft, rocket and missile components for service where unusual resistance to corrosion and high temperature is required.

Our Engineering Department will gladly consult with you regarding all brazing and allied problems, without obligation.

Have you seen our illustrated brochure, "Trail Brazing for the Space Age"? We'll mail it upon request.

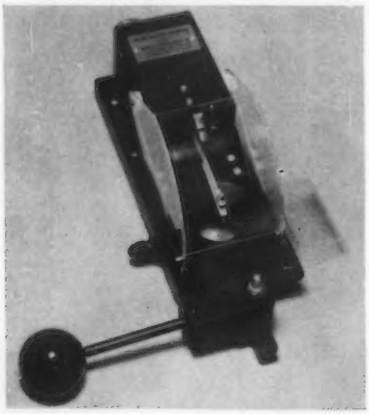
WESTERN ALLOY
ENGINEERING CO., INC.
847 Truck Way,
Montebello, California
RAymond 3-9937

Circle 62 on Inquiry Card

New Parts and Components

Pressure Calibrators

Dynamic pressure calibrator measures the transient response of pressure pickups and connecting lines. It applies a step pressure to the pickup which responds according to its mechanical and acoustical characteristics. A cellophane or acetate film is placed over pressure-pickup inlet. Pressurized air is applied to diaphragm thus produced. A solenoid-actuated knife bursts diaphragm, releasing pressure. A pressure step from a known positive valve to atmospheric pressure results. Relay contacts initiate a single sweep oscilloscope trace in advance of the diaphragm bursting. Pressure step ranges from 5 to 100 psi; rise time of pressure step is 0.1 millisecond (varies with connected volume). **Wiancko Engineering Co.**



Circle 164 on postcard for more data

Lox Converter

Ten-liter liquid-oxygen converter (used in F-105) conforms to USAF specification MIL-C-25777A. Incorporates stainless-steel inner-shell and aluminum outer shell. Weighs 15½ lb and measures about 13 in. Specifications are: evaporation rate, 2¾ lb/day; operating pressure, 70 psi; delivery rate 72 lpm for 1½ hr; temperature range, —65 to 260°F. **Linde Co.**

Circle 165 on postcard for more data

MONROVIA AVIATION *produces*

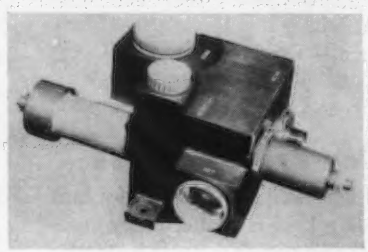
PRE-FLIGHT AIR CONDITIONING EQUIPMENT

with built-in **RELIABILITY**

Monrovia Aviation's Ground Support Air Conditioning Equipment is operational with the Bomarc Missile.

Combination Valve

Multi-purpose valve No. A-70198 combines high pressure hydraulic relief, a pressure reducer



and a check valve. It operates at pressures up to 4000 psi and at temperatures from –65°F to 275°F. Though designed for hydraulic fluid, per specification MIL-O-5606, it may also be adapted to other uses.—Vinson Engineering & Sales Corp.

Circle 166 on postcard for more data

Check-out Valve

System features an isolation valve which automatically cuts off the regular pressure supply to the gauge being tested, and simultaneously cuts in calibration pressure required to check gauge accuracy. The system is suitable for both gas and liquid testing panels. The isolation valve uses a sealed quick-disconnect coupling between the calibration source and the gauge being tested. A portable "Cali-Cart" is also available as a calibration pressure source. Futurecraft Distribution Corp.

Circle 167 on postcard for more data

Accelerometer

Sub - miniature, self-generating accelerometer is less than 0.1 in.

high, has 0.5 in. diam. and weighs ¾ gram. It is suitable for wind tunnel testing of simulated aircraft where weight and space considerations are important. This instrument may be used to determine

Built-in Reliability is a bonus design characteristic you can depend on in Monrovia Aviation's Ground Support Air Conditioning Equipment.

The portable unit illustrated fully meets all Military Specifications for air conditioning performance during pre-flight check-out of missiles and aircraft. Construction is rugged yet precise, with emphasis on airframe aluminum design for minimum weight and maximum strength. Controls are human-engineered for easy operation and maintenance. The entire unit has been carefully designed with *built-in reliability* constantly in mind!

MILITARY AND COMMERCIAL AIRCRAFT ASSEMBLIES

HONEYCOMB BONDED STRUCTURAL UNITS

ELECTRONIC GROUND SUPPORT EQUIPMENT

• *Write for Product Brochure No. AC 5.01.*

OTAL

APABILITIES

WITH HONEYCOMB BONDED ASSEMBLIES STRUCTURAL COMPONENTS AND GROUND SUPPORT AIR CONDITIONING SYSTEMS

MA — **MONROVIA AVIATION:** Producers of precision aircraft structural assemblies, Monrovia Aviation's products are installed on America's principal military and commercial jet aircraft. This Subsidiary also designs and manufactures customized portable air conditioning units for missile ground support purposes.

WG — **WHITTAKER GYRO:** Leading designer and manufacturer of electromechanical and non-electric gyroscopes, including rate gyros vertical gyros, and position gyros. In addition, this Division is active in the sub-systems field with stable platforms, inertial guidance equipment, and auto pilots for missiles.

WC — **WHITTAKER CONTROLS:** Designs and produces aircraft and missile fluid control systems, sub-systems and components. WC Products are in every production military aircraft and commercial airliner. In many of the nation's missile programs, Whittaker is also solving extreme fluid control problems.

TS — **TELECOMPUTING SERVICES:** Skilled in the establishment and operation of data processing centers, primarily for military and civil agencies of the Government. At White Sands Missile Range, TSI processes and analyzes missile test data. At Vandenberg AFB, this Subsidiary provides data processing services for SAC's 1st Missile Division.

ES — **ELECTRONIC SYSTEMS:** Specialists in systems management, this Division also designs and manufactures a wide variety of equipment in the fields of electronics and nucleonics for highly classified Military Programs. In addition, Electronic Systems designs and produces Air Traffic Control equipment for the Federal Aviation Agency.

DI — **DATA INSTRUMENTS:** Leading designer and producer of data reduction systems for ground support and range instrumentations. Product line includes shaft rotation digital equipment, decommutators, and other highly complex and specialized instruments for missile and aircraft testing, telemetering and in-flight operation.

EC — **ELECTRONIC COMPONENTS:** Designs and produces components, including magnetic amplifiers, transformers, micro-miniature relays, delay lines and high temperature ceramic capacitors. These reliable components are being selected for installation in many of the country's principal missile and space programs.

CB — **COOK BATTERIES:** Designers and manufacturers of automatically and manually activated silver zinc batteries for specialized missile application. These auxiliary power units provide primary or secondary electrical power. This subsidiary also, produces power conversion and other electronic apparatus.

MONROVIA AVIATION *Subsidiary of*

801 Royal Oaks Drive, Monrovia, California

Phone: ELliott 8-3211

MA

MONROVIA AVIATION

"Airframe components and Ground Support Equipment with Built-in Reliability!"

TELECOMPUTING CORPORATION

Los Angeles, California

Telecomputing Corporation is a unique combination of carefully integrated organizations. It is staffed with scientific talent of rare ability, created for the purpose of managing entire Space Technology and Weapon System Projects. Telecomputing is developing *advanced concepts* in industrial and military control systems.

Circle 63 on Inquiry Card

New Parts and Components

wing flutter, tab buzz or control system response. "Cement - down" mounting also allows accelerometer to be used on miniature electronic components. — Gulton Industries, Inc.

Circle 168 on postcard for more data

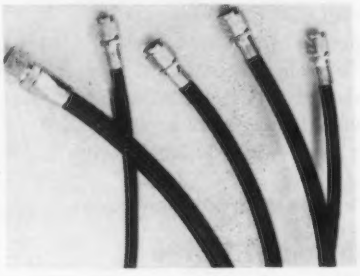
Rocket Engines

Off-the-shelf Cajun rocket engines are now available for immediate delivery to the industry. Model I is 108 in. long, 6¾ in. in diameter and weighs 172 lb. Model II and III vary slightly in length and weight. All produce over 8000 lb thrust. They can be used singly, in bundles and in multi-stage combinations. Other features include a safety filter which prevents premature firing due to electrical interference.—Thiokol Chemical Corp.

Circle 169 on postcard for more data

Nylon Pressure Hose

Light-weight, fungus-resistant Nylaflow hose is unaffected by flammable and non-flammable hydraulic



fluids, and has low freon permeability. It can be used with fuel, oil, hot paints, solvents, freon, and CO_2—The Polymer Corp. of Pa.

Circle 170 on postcard for more data

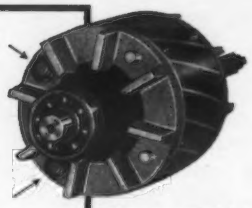
Transducer

Direct in flight measurement of torque delivered by small aircraft engines to the propeller is accomplished by this transducer. The pickup is mounted between engine and propeller. Provision is made to conduct the hydraulic fluid through the pickup shaft for normal pitch change operations; pickup is designed to withstand gusts and maneuvering loads. — Performance-Measurements Co.

Circle 171 on postcard for more data

Choose The Balancing Features That Meet Your Workpiece Needs EXACTLY on a Schenck

Completely efficient balancing is possible only on a balancing machine that can be adapted *exactly* to individual workpiece requirements. And this close correlation of method to part is possible only when you have a *complete* choice of various balancing methods. Schenck Balancing Machines offer you not just a wide variety of balancing methods, but the particular type of each method best suited to your component.



Motor armature with precast bosses. Balance corrected with washers (arrows)

Unbalance correction method	manually		semi-automatic		fully automatic			
Unbalance indicating system	componential				vectorial			
Number of correction planes	one		two		several			
Balancing Sensitivity (micro inches)	1,000	100		10		1		.1
Balancing Speed (rpm)	100		1,000		10,000			100,000
Drive method	belt		direct		air		own power	
Workpiece support	sleeve bearing		antifriction bearing		balancing fixture		own assembly	
Workpiece Weight (lbs.)	.01	.1	1	10	100	1,000	10,000	100,000
Workpiece Diameter (inches)	.1		1	10		100		1,000
Rotating Axis	Horizontal				Vertical			

Depending on your operation, Schenck can provide you with:

A highly efficient single-purpose machine.

An extremely flexible universal model.

Let us study *your* balancing program and suggest a Schenck machine adapted specifically to *your* requirements.

Write For More Information

Model R-02 Schenck Balancer

COSA

Importers of Leading Precision Machine Tools
Nationwide Sales and Service
COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

Men on the Move

LINCOLN VAN CAMP, named vice-president-production at Wyle Manufacturing Corp.

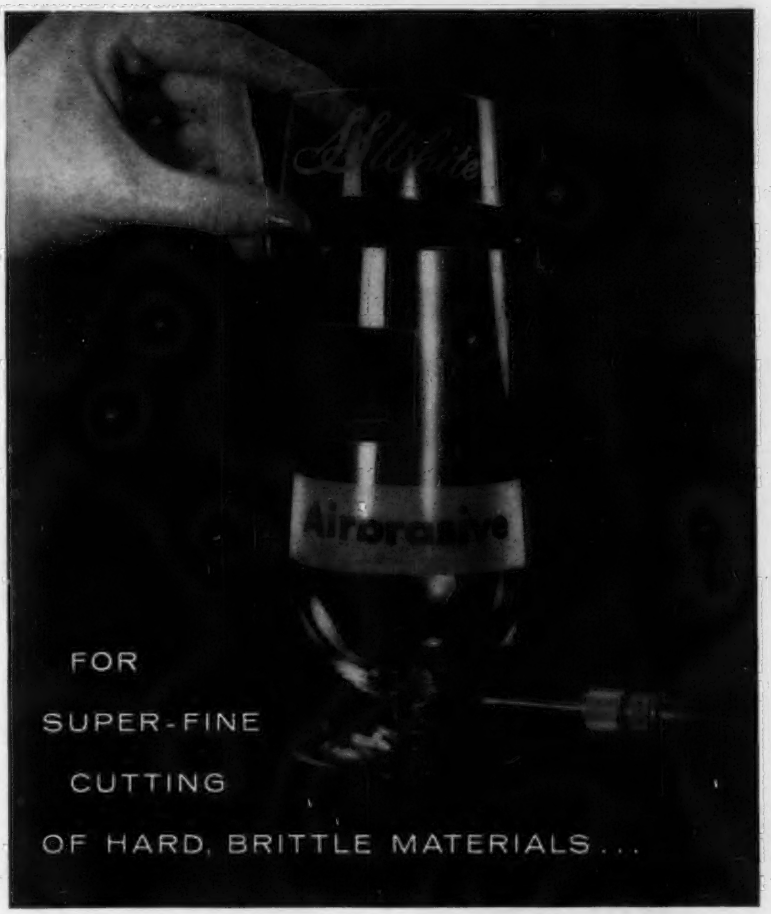
RALPH S. WHITE, named general manager of Electronic Systems Development Corp., subsidiary of Solar Aircraft.

PETER R. TOLLEY, named managing engineer to assist Canada in the licensed manufacture of General Electric's J-79 turbojet engines for Canada's F-104 Starfighters.

W. P. WOODS, named chief tool engineer for the Convair (San Diego) Div. of General Dynamics Corp.

JEROME C. JOERGER, appointed manager of Aerojet-General's Aeronautical Div. ROBERT H. KING, named manager of ordnance manufacturing at Aerojet-General—Downey.

continued on next page



THE S. S. White Industrial Airbrasive® Unit

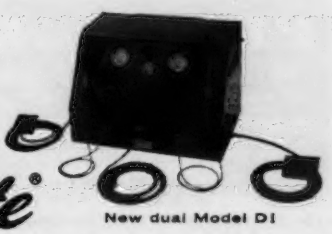
Not that we advise doing this to your fine crystal glassware, but it seemed to us a dramatic way to show you the versatility and the cool, shockless cutting and frosting action of our Industrial Airbrasive Unit.

Cuts as fine as .008" or large frosted areas are equally easy to make with this amazing industrial tool. A gas-propelled stream of abrasive particles quickly slices or abrades, as needed, almost any hard, brittle material, such as fragile crystals, glass, oxides, metal, minerals, ceramics.

Applications range from printed circuits, wire-stripping potentiometer coils, and cleaning off oxides... to shaping or drilling germanium. Every day new uses for the Airbrasive Unit are being discovered.

Send us your most difficult samples and we will test them for you.

SEND FOR
BULLETIN 5705A
...complete information



S. S. White®

New dual Model DI

S. S. WHITE INDUSTRIAL DIVISION • Dept. 18A • 10 East 40th Street, New York 16, N. Y.

Circle 65 on Inquiry Card

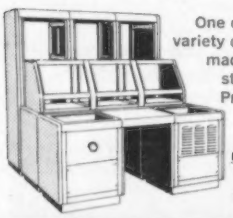
PREM-O-RAK

BALL-CORNERED MODULAR TRANSMITTER RACKS

22" and 25½" DEEP FOR STANDARD 19" RACK PANELS

Designed for MULTIPLE INSTALLATIONS and for use with PREM-O-RAK CONSOLE SYSTEMS.

RIGIDLY CONSTRUCTED • Frame made of 14 gauge steel • Panel Mounting Angles 3/16" thick • End Panels and Doors made of 16 gauge steel.



One of the unlimited variety of arrangements made possible with standard, flexible Prem-O-Rak units

CONTACT YOUR DISTRIBUTOR or SEND FOR FOLDER S-160A

PREMIER METAL PRODUCTS CO.
337 MANIDA ST., NEW YORK 59, N. Y.

WESTERN SALES OFFICE: 1485 Bayshore Blvd., San Francisco, Cal.
EXPORT DEPARTMENT: EMEC 127 Grace Street, Plainview, N. Y.
IN CANADA: PREMIER METAL HOUSINGS, Ltd., 5810 Smart Avenue, Montreal

Circle 67 on Inquiry Card

Men on the Move

FREDERICK E. BURNHAM, named president-finance, Chance Vought Aircraft.

DR. EARL A. WEILMUENSTER has joined the technical staff of the United Research Corp. as assistant manager of the Propellant Development Branch.

R. L. MARQUARDT, named director of sales for Rocket Operations, Thiokol Chemical Corp. with headquarters in Utah.

KENNETH G. FARRAR, named vice president in charge of manufacturing and CHARLES B. BUCKLEY named assistant to the president-Corporate Planning and Development; at Douglas Aircraft Co.

DR. RUSSELL D. O'NEAL, elected vice president in charge of engineering; ROY J. SANDSTROM appointed general manager; and L. B. YOUNG named assistant general manager; at Bendix Aviation.

WILLIAM C. HITT, named executive director of Ultrasonics for Automation Industries.

A. CLYDE FLACKBERT, appointed manager of administration for Tactical Weapon Systems Operations at Aeronutronic, Div. of Ford Motor Co.

CLYDE SKEEN has joined Temco Aircraft Corp., as executive vice-president and general manager.

VICTOR H. SOUCEK, appointed manager of special projects, Sanders Associates.

NEW AEROSPACE BOOKS

Ask for FREE Descriptive Catalog

More than 600 Aero titles in stock!

ROCKET ENCYCLOPEDIA ILLUSTRATED. Edited by John W. Herrick & Eric Burgess. 600 pages of definitions & text; 450 illustrations! Power & applications, assemblies, components, accessories, test equipment, etc. Large 7¾ x 10¾ size. **$12.50**

FUNDAMENTALS OF GUIDED MISSILES, by Air Force & Aero Publ. Staff. Profusely illustrated coverage of design, theory, operation, maintenance. 600 pages, 620 illustrations! **$12.50**

FUNDAMENTALS OF STRESS ANALYSIS, by Deyarmond & Arslan. New 2nd Edition of popular book on basic principles, loads & stresses, section properties, allowable stresses. **$5.75**

CIVIL AIR REGULATIONS & REFERENCE FOR MECHANICS, by Aero Publ. Contains all regs that mechanics must know. 1960 edition. **$2.50**

CIVIL AIR REGULATIONS & FLIGHT STANDARDS FOR PILOTS, by Aero Publ. One million copies of previous editions! 1960 edition. **$2.50**

AERO PUBLISHERS, INC.

2162 Sunset Blvd. • Dept. AM • Los Angeles 26, California

Circle 66 on Inquiry Card

Industry Notes

British Aircraft Groups Form

It is now possible to see the final pattern and organization of the British Aircraft Industry. The large English Electric and Vickers concerns which have already been cooperating in the design sphere, have combined with Bristol Aircraft to form a large aircraft and missile group. It is anticipated that the small Hunting Aircraft concern will also join this group soon.

By far the biggest group is the Hawker Siddeley giant which, subject to the approval de Havilland and Blackburn shareholders, will control no less than eight aircraft companies. About 50 per cent of this groups output is non-aeronautical and it is certain that some of its branches will have to turn to other forms of engineering when present orders are finished.

A third group will specialize in helicopter and VTOL aircraft as well as naval aircraft. This combine is headed by Westland Aircraft and it will be the largest producer of helicopters in Europe without question. Embodied in the group are Saunders-Roe, Bristol Helicopters, and Fairey Aviation.

Only four aircraft makers are not accounted for in the major groups and it is most likely that they will remain independent for the time being. Of these Scottish Aviation and Auster Aircraft are very small concerns specializing in the STOL light transports and club aircraft. Handley Page is a large concern with a good order book now making the Victor bomber and Herald feeder line transport. Last of the quartet is Short Brothers and Harland Ltd., a concern owned jointly by the British Government, Harlands and Bristol Aircraft, the government having the lions share and consequently control.

Engine manufacture is in the hands of two major concerns, Rolls-Royce and Bristol Siddeley. Others such as Alvis, Blackburn, Napier and de Havilland all produce engines on a much lesser scale.

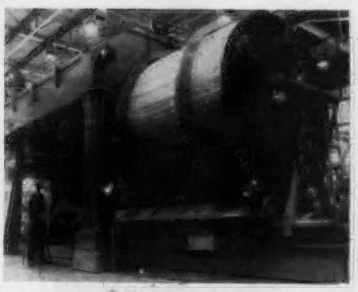
NASA SPACE VEHICLE PLAN FOR DECADE

Highlights of NASA's recently-announced Space outlook for the next ten years:

- 260 satellites and deep space probes;
- Increasing budget requests—over $1 billion in FY 1962, $1.5 billion a few years later;
- At least 27 Saturn and at least 3 Nova vehicles;
- Atlas used with 104 of the 260 shots, and 88 of the 104 will have Agena B or Centaur upper stages;
- Thor is scheduled with 57 shots, and 43 of these will be with Agena B;
- 56 Scout vehicles will be fired;
- Eight Redstones, five Juno II, two Thor Able, one Atlas Able, and 12 Thor-Deltas remain to be fired. These boosters will be phased out of NASA's program in the next few years.

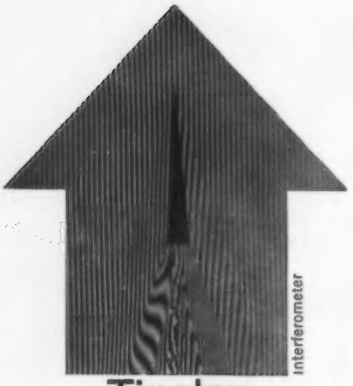
continued on next page

"MISSILE-EARS" on Thor reentry vehicle are actually ion-sensors. Engineer points to meteor detector.

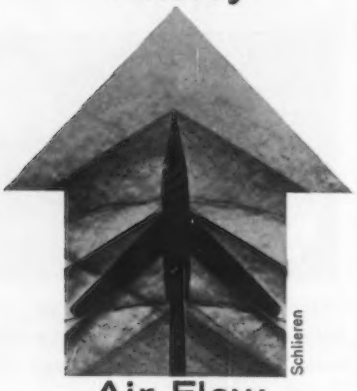


TITAN FIRST STAGE skin panels are automatically welded by barrel fixture at Martin-Denver.

FILLER SNAKE developed by Hexcel Products has aluminum foil segments 0.005 in. wide.



Tinsley



Air Flow

Visualization

From design to construction to installation, Tinsley will develop a complete optical mechanical system to meet your performance requirements for visualization in wind tunnels, arc tunnels, shock tubes, plasma jets. Among our clients: Douglas, Lockheed, NASA, North American, Rocketdyne, Republic. For literature write Air Flow Dept. TINSLEY LABORATORIES, INC., 2526 Grove Street, Berkeley 4, Calif.

Circle 70 on Inquiry Card

Industry Notes

PRESIDENT PROPOSES SPACE ACT CHANGES

Space Act Amendments proposed by President Eisenhower would lessen chief executive's management responsibility for the space program. National Aeronautics and Space Council would be abolished. So would the Civilian-Military Liaison Committee. To eliminate duplication, the president could assign development projects to NASA or the Defense Dept. regardless of whether these were aimed at military or civilian use.

Contracts

The Martin Co.—$82,599,690 for research and development on the Army's Pershing.

Raytheon Manufacturing Co.—$42,402,854 for Army's Hawk missiles, plus test equipment and engineering services.

Western Electric Co.—$5,816,800, R&D on Army's Nike Hercules

Texas Instruments—$4,500,000 to produce an advanced antisubmarine warfare system for the Navy.

Western Electric—$30,000,000 for 18 sites comprising world-wide chain of tracking stations. NASA awarded contract; and will use stations in its Mercury program.

Kaman Aircraft Corp. — $14,000,000 for producing HU2K-1 helicopters for the Navy.

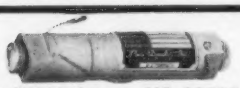
Convair-San Diego — $8,000,000 to modify nine F-106 Delta Darts for the Air Force and purchase long-lead-time items for modifications on another 26 planes.

General Electric's Production Engine Dept.—$17,000,000 for J79 turbojet engines.

PneuDraulics, Inc.

in-line Hydraulic Relief Valves to **new specification*** MIL-V-8813 (ASG) for type II systems. Also applicable to type I systems.

MS 28893-A4 MS 28893-C4
MS 28893-B4 MS 28893-D4



MS 28893-A6 MS 28893-C6
MS 28893-B6 MS 28893-D6

MS 28893-A8 MS 28893-C8
MS 28893-B8 MS 28893-D8

*MIL-V-8813 (ASG) (Supersedes MIL-V-5523B)

- *Higher operating temperatures (275°F)*
- *Lower spread — full flow to reseat*

Especially applicable to auxiliary power system pressure control.

Valve Features: 1. No Dynamic O-Rings, no hysteresis; 2. Dash pot, no noise or chatter; 3. No outlet jet effect; 4. Flow compensated operation; 5. Light wt., low stress springs.

PneuDraulics, Inc.

8961 Central - Montclair, Calif. - NA 9-0677

Request Technical Information on your letterhead

Circle 68 on Inquiry Card

Torque Wrench Adapter
Calculator Slide Rule
Free
Instantly calculates scale conversion factors for adapters of different lever lengths—set it and read it.
Provides automatic selection of proper torque wrench for adapters and/or proper adapters to go with given torque wrenches.
Sent free upon request, compliments of
PA STURTEVANT CO.
ADDISON QUALITY ILLINOIS

Circle 69 on Inquiry Card

General Electric's Jet Engine Dept.—$10,000,000 to further develop the J93 turbojet for the Air Force; $5.5-million for improving the J79 engine.

Ryan Aeronautical Co. — $6,000,000 for fuselage sections for the Boeing KC-135.

GPL Div. of General Precision Inc.—$3,700,000 for airborne navigation systems.

R & D Briefs

Air cushion structures are being studied under Navy contract at Ryan Aeronautical.

Instrument probes of radiation continue this year. Air Force is developing six new 60 lb instrument packages which will be loosed from Atlas missiles by explosive bolts.

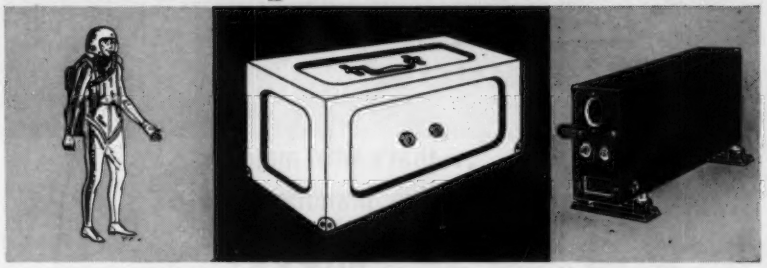
Radio waves can be propagated at low loss over a newly-discovered transoceanic atmospheric duct. Navy-Air Force experiments took place between South America and Africa. They showed duct about 500 ft. thick, centered about 5,000 ft. high.

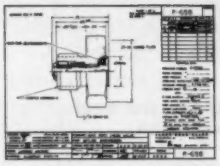
Hydraulic power package for Polaris in-flight control will be designed and developed by General Electric's Aircraft Accessory Turbine Dept., Lynn, Mass.

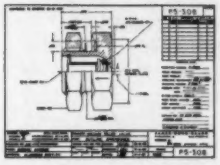
continued on page 169

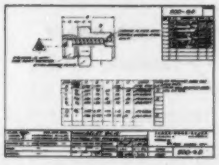
MERCURY ASTRONAUT will look through heat resistant windows developed by Corning Glass.

CIRCLE SEAL *specialized* RELIEF VALVES









For applications such as pilot suits, shipping containers, black boxes...

Circle Seal special relief valves provide:

- Protection against excessive pressure differentials
- Protection against moisture, dirt and contaminants
- Protection against vent port malfunction on missile solenoid valves
- Protection against electronic equipment damage
- Protection against pilot suit overpressurization

Circle Seal's many specialized valves provide "dead tight" sealing where it is required. They have been operationally proven in critical airborne applications—problem areas you may be exploring right now. Circle Seal's engineering know-how and experience can help you find the right solution.

Write for free engineering data!

CIRCLE ® SEAL *precision valves*

JAMES, POND & CLARK, INC.

2181 East Foothill Boulevard
Pasadena, California

Circle 71 on Inquiry Card

Every screw machine man NEEDS this basic thread data . . . .
VOL. V
THE EASTERN MACHINE SCREW CORPORATION
UNIFIED AND AMERICAN NATIONAL SCREW THREAD DATA
COMMENTS BY THE EASTERN MACHINE SCREW CORPORATION
GET YOUR COPY free!

Thread forms of Canada, Great Britain and United States . . . Unified and standardized . . . Major, minor and pitch diameters with tolerances . . . Over 600 internal and external threads. Your name and address on the margin is all we need

THE EASTERN MACHINE SCREW CORPORATION • 61-21 Barclay Street New Haven, Conn.

Circle 72 on Inquiry Card

MISSILES BREATHE TOO YOU KNOW...

...that's why major missile manufacturers specify **MIDGET LOUVERS**

"REGULAR" —with screen and all-weather deflector.

"LD"—screened for interior and protected exterior locations.

In seven sizes to meet your needs —one inch through six inches. Available in chrome, aluminum and copper rustproof finish ... installs easily and quickly. Write for our catalogue sheet.

MIDGET LOUVER COMPANY
6 Wall Street • Norwalk, Conn.

Circle 74 on Inquiry Card

Tensile Testers

• Motorized • Bench-Mounted
• Easy-to-Operate • Low Cost
Capacities from 1,000 to 20,000 lbs.

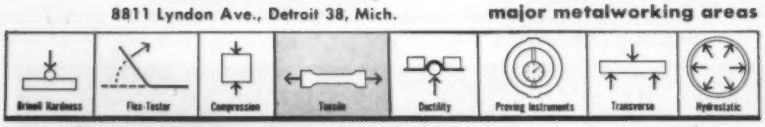
Available in two general sizes that occupy minimum space and provide consistently accurate and dependable results. Simple, easy-to-use controls are conveniently located on front of base. Jaws are quickly changed to accommodate specimens of different sizes. Operation is hydraulic; powered by 1/6-hp. 110-v motor. Load gage is protected from specimen-fracture shock by rubber mount. Twin load gages and floor stand are available as optional equipment.

Write or call if you have any special testing problem

These machines are designed to also perform compression tests.

Steel City Testing Machines Inc.
8811 Lyndon Ave., Detroit 38, Mich.

Distributors in most major metalworking areas



Circle 73 on Inquiry Card

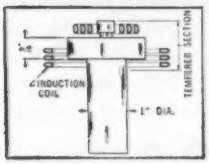
LepeL

HIGH FREQUENCY INDUCTION HEATING UNITS

HARDENING · ANNEALING
ZONE REFINING · CRYSTAL GROWING
SOLDERING · BRAZING

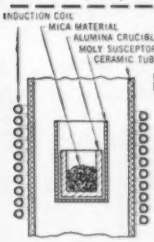
Lepel induction heating equipment represents the most advanced thought in the field of electronics... the most practical and efficient source of heat developed for numerous industrial applications. You are invited to send samples of work with specifications. Our engineers will process and return the completed job with full data and recommendations without cost or obligations.

TYPICAL INDUCTION HEATING APPLICATIONS



Punch Heads Selectively Tempered

Diagram shows arrangement for selectively tempering heads of alloy steel punches. The use of a combination type solenoid and pancake induction coil reduces hardness from Rc 55/56 to Rc 41/44, improving resistance to brittle fracture at the head of the punch. In this case a heating cycle of 55 seconds provides uniform tempering. A multiple position fixture, processing 4 pieces at one time, speeds up production.



Heating Non-Conducting Materials To High Temperatures

Laboratory analyses frequently require heating of non-conducting materials to temperatures of 3,000 to 3,500° F. in vacuum or special atmosphere. This can be accomplished by induction heating with the aid of a metal susceptor. Diagram shows the fusion of mica samples in an alumina crucible, using molybdenum susceptor. A ceramic tube surrounding the susceptor isolates the work for fusion in a vacuum. The molybdenum susceptor is heated by induction, which in turn, heats the crucible by radiation.

WRITE FOR NEW LEPEL CATALOG
Electronic Tube Generators from 1 Kw to 100 Kw
Spark Gap Converters from 2 Kw to 30 Kw

LepeL HIGH FREQUENCY LABORATORIES, INC.
55th ST. & 37th AVE., WOODSIDE 77, N. Y.

Circle 75 on Inquiry Card

Industry Notes

R & D Briefs . . . continued

New self-broaching fastener concept is being used in Thor's liquid oxygen compartment with Huckbolt fasteners.

Heat sinks have been developed withstanding 30,000°F for fractions of a second and 9000°F for several minutes. Research is at Chrysler's Missile Div.

TV camera capsule, ejected from Redstone at White Sands Jan. 26, withstood wind tunnel tests up to 900 mph. Capsule used plastic .125 inch thick. Capsule has been developed as an Army reconnaissance device to transmit photographs of the impact point of the missile for purposes of damage assessment.

Hypersonic nozzle developed and manufactured by the Electronics Division of the Gorham Manufacturing Co. is credited with helping achieve wind tunnel velocities of more than 5300 mph in the wind tunnel of the Naval Supersonic Laboratory at M.I.T.

continued on next page

GOLD COATING is applied to rocket part at Chance Vought Aircraft. Part is then baked at 375°F for 15 minutes.

THE GRAND CENTRAL REPORT

RESEARCH PROGRESS ON THE SOLID ROCKET

By May 1st of 1960, the Grand Central Rocket Co. will complete a magnificent modern solid propellant research laboratory at the company headquarters site, Redlands, Calif.

This laboratory will be the workshop of some of the world's top propellant specialists. We have already allocated over $3 million for research aimed at developing more "specific impulse" in solid propellants. The current priority item is the development of the Nitrasol series of propellants, a most promising propellant and one with which we have already had considerable success.

Within a year, we hope to develop a high-density, high-energy Nitrasol propellant for missile and space applications.

The external ballistics of many missile applications are favored by high density in the propellant, even at some sacrifice of "specific impulse." A recent parametric study of a large missile, for instance, showed that a range increase could be achieved merely by increasing the density of the propellant in the first stage, even if the specific impulse were lowered at the same time. This finding has been confirmed by research done independently and concurrently by the Grand Central Rocket Co., where laboratory studies on the subject are continuing.

Where possibilities of achieving such major breakthroughs exist, the Grand Central Rocket Co. management and its top-flight scientist teams believe that development should be vigorous. This is the fundamental policy that has produced such a long list of distinguished accomplishments in solid propulsion for our company.

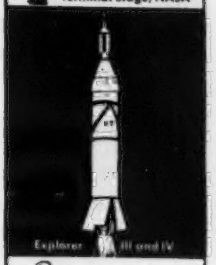
Positions open for chemists, engineers and solid rocket production specialists.

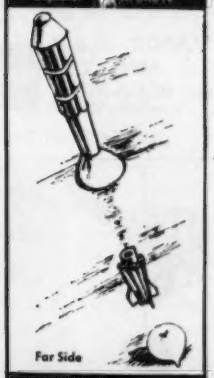
Grand Central Rocket Co.

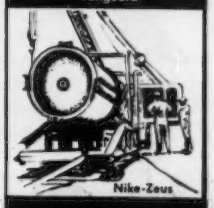
An Affiliate of Petro-Tex Chemical Corporation And Lockheed Aircraft Corporation

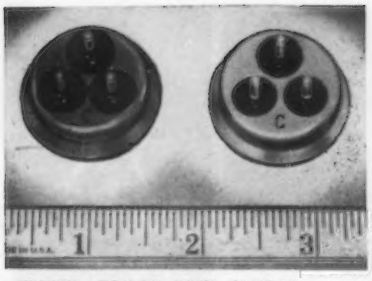
P. O. Box 111 Telephone: PYramid 3-2211

REDLANDS, CALIFORNIA









FUSED GLASS AND METAL MISSILE PARTS CLEANED QUICKLY AND WITHOUT DAMAGE TO GLASS GLAZE

with **VAPOR BLAST**

Liquid Honing*

Vapor Blast Liquid Honing process cleans metals fused to glass without removing glaze or damaging the glass.

Yet the metal parts are thoroughly cleaned, burrs removed, in shortest possible time.

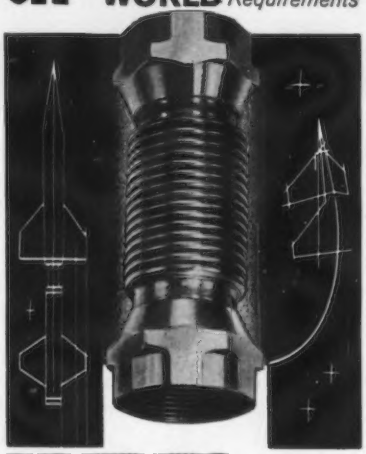
Bring or send parts for test cleaning. No obligation.

*Liquid Honing and Vapor Blast are trademarks.

VAPOR BLAST MFG. CO.
3035 W. Atkinson Ave.
Milwaukee 16, Wis.

Circle 56 on Inquiry Card

up to **OUT-OF-THIS WORLD** *Requirements*



U.S.Flex

STAINLESS DUCTS and BELLOWS

- Handle high temperature corrosives
- Withstand drastic pressure changes, vibration and sinuous alignment

WRITE TODAY FOR TECHNICAL DATA

U.S. FLEXIBLE TUBING CO.
213 MAIN STREET, BARTLETT, ILL.

Circle 57 on Inquiry Card

DO YOU REQUIRE PARTS PRODUCED TO THE ACCURACY OF THIS GENEVA STARWHEEL?

ACTUAL SIZE

REGISTER: Slot to Slot — .0001
Center to Center of Adj. Radii — .0001

TOLERANCES: Slot Width — .00005
Radii Size — .0001
Radii Location — .0001

SURFACE FINISH: Slots — 8 RMS
Radii — 16 RMS
Shaft — 4 RMS

Critical work of this nature has been the specialty of LaVezzi for over 50 years. The requirements you have for small high precision parts including difficult operations, fine finishes, critical deburring, etc., can be handled efficiently by LaVezzi. We are anxious to serve you and invite your inquiries and quote requests. Write today for illustrated brochure.

LaVezzi **MACHINE WORKS**
4635 WEST LAKE ST., CHICAGO, ILLINOIS

Circle 77 on Inquiry Card

Industry Notes

R & D Briefs . . . continued

Plasma-jet generating 18,000°F is being developed at Bell Aircraft Corp. to test materials for satellites and space ships of the future.

System measuring and recording all shock and temperature change damage occurring in a solid propellant missile until it is ready for launching has been developed at Avien Inc.

Portable missile service structure 15 stories high has been developed by the Army Engineer Research and Development Laboratories. It is mounted on two base trailers of six-wheels each. Designer-builder: Noble Co.

Satellite orbits are being computed at Aeronutronic, div. of Ford Motor; studies include communications.

New power sources for missile propulsion are under development at Cross-Malaker Laboratories.

New epoxy resins, differing in molecular structure from conventional epoxies, are being introduced by Food Machinery and Chemical Corp. Materials are known as the OXIRON series.

Research quantities of the following rare chemicals are now available to the industry at Hummel Chemical: Hexanitroethane, Trinitromethane, Trinitroethanol, Tetranitromethane, Ammonium Nitroform, Potassium Nitroform, Hexanitrodiphenylamine, Trinitrophenylmethylnitramine, and Nitrate of amines to nitramines.

Thermoplastic Recording system combines speed and versatility of magnetic recording and the storage capacity of photography. It is being developed by General Electric Research Laboratory, Schenectady.

Boeing bioscientists blanched green algae under fluorescent lights, producing palatable white algae.

Experimental graphite rocket nozzles protected by a coating of up to ⅛-in.-thick high-density tungsten are being produced for the U. S. missile space program by The Alloyd Corp.

Production Techniques

Furnace-bond aluminizing process for high temperature service with steel applications was developed by Stainless Processing Div., Wall Colmonoy Corp.

Die-handling table, especially designed and produced by The Colson Corp., has simplified production of Nike-Hercules airframe at the Charlotte Div. of Douglas Aircraft Co. Table has 30,000 lb capacity; feeds and removes a variety of dies for the beds of two giant hydraulic presses.

Electronic rivet head inspection device, developed by Boeing Transport Div., indicates to the ten-thousandth of an inch, any deviation from standard in rivets.

Free-rolling wheel for material-handling equipment lessens vehicle's rolling resistance by estimated 75 per cent. It was developed by Palmer Manufacturing Co. and Naval Air Development Center.

continued on next page

REINFORCED PLASTICS gave this structure at Zenith Plastics Co. a strength-to-weight ratio above one million inches.

MicroRold®

STAINLESS STEEL

SHEET & STRIP

FIFTEEN YEARS AGO, we were the first stainless steel sheet producer to recognize the superiority of the Sendzimir Cold Reduction Process over conventional rolling equipment for exceptionally close tolerances.

Our equipment is such that tolerances can be held to as low as 3% (plus or minus), as compared to the A.I.S.I. maximum allowable variation of 10%. This "Thinness Control" means the ability to control decimal thickness with micro-accuracy, giving you more stainless area per ton or the equivalent area with less weight. It is this controlled accuracy and uniformity that directly relates to fabricating economies and satisfaction in the ultimate end use.

MicroRold Stainless Steel Sheet is available in widths up to 36" in gauges from .005 to .109, and in widths up to 48" from .010 to .109 in all commercial grades, finishes and tempers. MicroRold Strip can be supplied in widths up to 23 15/16" in gauges from .010 to .109, and VERI-THIN Strip as thin as .0015 to .009 in all commercial strip finishes.

Distributed by steel warehouses throughout the world!

Send for your copy of "MicroRold Stainless Steel Handbook"

WASHINGTON STEEL CORPORATION

WOODLAND AVENUE • WASHINGTON, PENNSYLVANIA

Industry Notes

A Researcher's View of Global Communications

Here is one research specialist's calculations for an operational, permanent global satellite-communications system.

According to C. T. McCoy of the Philco Research Div., three "stationary" satellites could weigh as little as 50 lb. Each would include:

- Radioisotope-powered electrical generator. About 50 watts total power in each 10-meter-diam. satellite would be used for receiving, processing and relaying radio and tv signals.
- Detector to tell when satellite control lens does not point precisely at a ground-based beam.
- Trimmer for correcting satellite orientation towards ground and other satellites. These might be ion emitters. Exact orientation appears to be one of the chief problems which will be faced.
- Several Mylar-type one-square-meter printed circuit antennas for radio-tv communications.
- Three lens, one for ground control, two for relaying radio and tv to other two satellites.

Less than 10 watts of ground-based power would be needed for the radio-tv beam, according to McCoy. Control beam would require about one watt.

The radio-tv signals would be transmitted through the atmosphere in the 2000-5000 megacycle frequency. These would be converted and then relayed through one-square-foot lens.

At 22,290 ft., relaying would use only a few watts at one micron radiation wavelength, adds McCoy. Beam would be about a tenth of a milli-radian. This requires extremely precise positioning.

Because of the extreme wastefulness of scattering in a "passive" satellite system, McCoy believes the "active" satellites have the real development potential.

One-square-meter dishes or screens would be used with modified television receivers. No towers would be needed. McCoy believes the receivers will be priced about the same as present-day UHF sets.

McCoy has directed Philco research on IF and video frequency domains. He is the author of a volume on the theoretical limitations of space communications systems. *continued on page* 174

VALUABLE REFERENCE

free 84-PAGE CATALOG

One Complete Source of Detailed Specifications for Designers, Production Managers, Toolroom Foremen

Hundreds of NEW ITEMS

ALL NEW — Complete specifications and cost saving data on over 2000 "Standards", including world's largest line of work-holding equipment, chuck jaw blanks, handles, knobs, wheels, strap clamp assemblies, forged items, plus hundreds of other jig and fixture components. Detailed specifications, engineering drawings. The one complete source for data on all the "standards" for tool, die, jig, and fixture design and application. Write for your FREE copy today.

JERGENS TOOL SPECIALTY CO.

Dept. AH-3 712 E. 163rd St., Cleveland 10, Ohio

Circle 80 on Inquiry Card

My name is Paul M. Platzman,

I pioneered the ultrasonic industry. Two well known ultrasonic companies were founded by me. Now, my new organization, Ultrasonic Industries, Inc. is mass producing and selling ultrasonic equipment. No middleman's profit in this factory—direct-to-consumer deal. Tremendous savings are passed on to you. Ultrasonic cleaners are now within the range of everybody's budget. My products stand out because of their unbelievably low money-back-guaranteed prices, free five year service contract, and consistent trouble-free performance under the most gruelling conditions. This is possible because my generators and transducers incorporate the latest advances in ultrasonic technology.

FABULOUS INTRODUCTORY OFFER $99.95 ½ gal. cap.

Including tank, connecting cable, and instruction manual (export model: 220V-50 cycles: $7.50 add'l.). We will pay all shipping charges to any point within the U.S. (except Alaska and Hawaii) if you enclose check with order.

5 DAY TRIAL

Money refunded (less shipping charges) if not completely satisfied.

Unprecedented 5 year service contract

The DISONtegrator-System 40 is available from stock for immediate delivery in unlimited quantities.

FOR THE FIRST TIME

A choice of 6 beautiful colors for office or laboratory decor: Ivory, Wheat yellow, Turquoise, Desert sand, Pale green, and soft grey. Specify color when ordering.

DISONTEGRATOR® ULTRASONIC CLEANER

THE LOWEST PRICED ULTRASONIC CLEANER EVER SOLD! Buy one or 100 and save! Rugged, Efficient, Versatile, Fast ...Cleans in Seconds · Simple One Knob Control · Compact · Saves Time and Money!

DISINTEGRATES injurious soils instantly! Semiconductors, relays, crystals, switches, precision potentiometers, optical parts, lenses, timers, meters, ceramics, gears, printed circuit boards, castings, bearings, filters, screens, valves, missile and avionic parts, and instruments.

SEND CHECK WITH ORDER NOW TO: DEPT. 5-AM-3

ultrasonic industries INC.

141 ALBERTSON AVENUE · ALBERTSON, L. I., N. Y. · PIONEER 1-4333

Circle 79 on Inquiry Card

BECAUSE THIS FAILED

the bird didn't fly

FOR SUCH PROBLEMS more nondestructive tests can help

Often the reason why a missile fails is clear enough — after the failure. A component or system didn't function.

But this may be only half the answer.
Why did the system or component fail?

Was there an unknown defect, crack or leak or metallurgical abnormality that could have been discovered—with the proper nondestructive testing system? Or was the part or material being "worked" within a hair-line of maximum capacity of known *perfect* samples or "handbook" values—without full nondestructive testing? The nondestructive test is entirely different from a physical overload test, and proves out different things!

When the designer must assume near perfection to attain planned performance, the integrity of every element in the system, and of every material and part must be nondestructive tested—proved—and known. At present does the designer know?

Through proper use of many nondestructive tests, the means are available—or can be developed. Many of these are now provided by Magnaflux, ready for immediate use. They are used less than maximum now!

Where no existing systems meet the need, we are ready to work with any responsible agency in an authorized Research and Development program. We have 30 years of specialized testing knowledge, and a dozen or more testing systems.

We sincerely believe that lack of full use of proper nondestructive testing is a problem of national importance that must be met head-on. We offer our help.

Manufacturers of:

MAGNAFLUX MAGNAGLO to test magnetic materials for cracks, seams, etc.
ZYGLO for nonmagnetic and other materials; cracks, leaks, etc.
SONIZON Ultrasonic Thickness Measuring
STRESSCOAT to find and measure stress on parts, overall!
MAGNATEST electronic testing for hardness, conductivity, alloy, proximity, and many more.
And still other methods and techniques, some completely new.

MAGNAFLUX CORPORATION
A Subsidiary of General Mills
7326 West Lawrence Avenue, Chicago 31, Illinois
New York 36 • Pittsburgh 36 • Cleveland 15
Detroit 11 • Dallas 35 Los Angeles 22

The Hallmark of *Quality* in nondestructive test systems

ACOUSTICA ULTRASONIC CLEANING CUTS COSTS!

Much better cleaning!
Much less time!

In seconds—all dirt, dust, and soils are "cavitated" away *ultrasonically!* No scrubbing, no disassembling, no costly maintenance. Hard-to-get-at parts are cleaned swiftly and thoroughly. Modern Acoustica ultrasonic cleaning is rapidly replacing older methods. Send for details of complete line of Acoustica ultrasonic equipment and cleaning chemicals. Acoustica Associates, Inc., Fairchild Court, Plainview, N. Y. • 1042 Aviation Blvd., Los Angeles, Calif.

acoustica
ULTRASONIC CLEANING SYSTEMS

Circle 82 on Inquiry Card

Industry Notes

New Facilities

Thiokol Chemical Corp.'s Brigham City, Utah, plant, now under construction, will produce the first stage of Minuteman. It will employ about 1400 people.

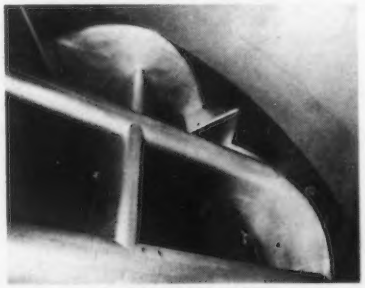
Rocketdyne is completing new Canoga Manufacturing Bldg. to consolidate manufacturing facilities in the Los Angeles area.

Douglas Aircraft will consolidate missiles and space systems engineering in center now being established at the firm's Culver City facility.

Sperry Gyroscope Co. is studying behavior of infra-red radiation in planetary atmospheres. Special test facilities were built within 86-foot-long tunnel whose blackened walls aid in controlling background radiation.

Aeronutronic Div. of Ford Motor Co. is occupying a new building at Natick, Mass. for its work on satellite orbits. The division is consolidating all basic research functions into its Research Operations.

Lockheed has plans for building a hypersonic wind tunnel at Marietta, Ga. this year. Firm recently dedicated its Space Surveillance Center at Sunnyvale.



WATER-COOLING facility provides 65,000 gallons per minute to supersonic wind tunnel at the Arnold Engineering Development Center.

Aerospace Log

Jan. 14 — Javelin sounding rocket launched by Air Force to 670 miles.

Jan. 16—Shotput II launched from Wallops Island, Va. Its 100 ft mylar sphere is used to study wind currents in upper atmosphere and for bouncing back radio signals.

Jan. 20—U.S.S.R. fires test rocket 7766 miles into test area 1100 miles southwest of Hawaii. Claims landing 1.24 miles from target.

Jan. 21—Miss Sam, 7½ lb monkey, rides 48,900 ft high in test of Mercury escape system. Capsule was boosted by Little Joe rocket. Miss Sam survives air loads of 1000 psi.

Jan. 23—X-15 powered flight reaches 60,000 ft, 1300 mph.

Jan. 26—"Skyhook" gondola with 800 lb film pack cut loose when balloon goes off course 22 miles up. Destroyer picks it up in Eastern Caribbean.

Jan. 27—Polaris carries dummy warhead to target 900 miles down the Atlantic Missile Range.

Jan. 27—Titan dies on launching pad in third attempt to launch with complete second stage.

Feb. 2 — Ryan Vertiplane crashes shortly after take-off. Pilot bails out safely from 1000 ft.

Feb. 2—Titan makes successful flight with functioning second stage; shot is not aimed at full 6000 mile range.

Feb. 3—Army test fires Nike Zeus booster and sustainer motor in new 1600 sq mi safety area at White Sands.

Feb. 4—Discoverer IX fired, fails to reach planned polar orbit.

Feb. 4—Jupiter test phase at Canaveral ends with successful 1500 mile flight. Polaris launched successfully for 900 mile flight.

Feb. 4—Radar signals bounced off sun's corona from transmitter at Stanford University; "echo" received.

Proved! New, Better Way to Seal Drilled Holes with . . .

Less weight!

Less cost!

NEW PIN-PLUGS°

Seal simply, positively
Prevent costly leaks!

Now — forget conventional, costly methods of sealing holes that serve as flow or pressure passages. The Lee "Pin Plug" is a cylindrical plug with a tapered reamed hole partway through its center and numerous small grooves on its outside surface. Simply place it into reamed hole and drive in the tapered pin until ends are flush. Controlled expansion causes grooves in plug to "bite" into casting and form independent seals and retaining rings. Extensive laboratory tests report no leaks under normal pressures, often show bone dry seals up to pressures of 40,000 psi.

Now successfully and widely used on aircraft and missiles — for pumps, servo valves, regulators, etc. Available steel and aluminum and in both long and short series.

° Pat #2,821,323

LEE Co.

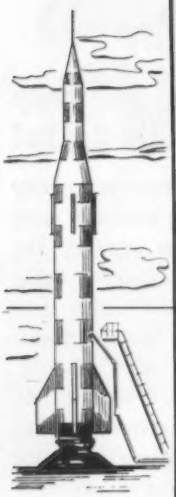
SOME TERRITORIES STILL OPEN FOR QUALIFIED TECHNICAL SALES REPRESENTATIVES.

Write today for Standard Sizes and Engineering Data

THE LEE COMPANY OLD SAYBROOK, CONN.

Circle 83 on Inquiry Card

1st CHOICE...NOW *and for the* FUTURE



BARCO FLEXIBLE **JOINTS** (*Gimbal or Swivel*)
FIRE-SAFE
PRESSURE-SAFE
SHOCK-SAFE
DETERIORATION-SAFE

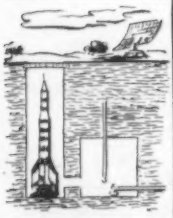
Barco is the leader in providing "Flexibility for Metal Piping"—the key to safety, permanence, and reliability wherever construction involves flow of fluids in missile launching, ground support equipment, or permanent base installations. Barco Flexible Joints are backed by years of successful engineering experience in this field and are available in sizes, styles, and types to meet current project requirements. Specify BARCO—NOW and for the FUTURE!

FOR MISSILE FUEL LOADING LINES

Barco "LOX" Joints meet requirements and have passed the official "qualification test" for handling cryogenic and other fluids used in fueling missiles, including liquid oxygen, nitric acid and other chemicals. Barco Joints for liquid oxygen are used for thermal contraction in piping and for making metal loading lines that are easily movable, flexible, and SAFE.

FOR HYDRAULIC ACTUATING LINES ON GROUND SUPPORT EQUIPMENT

Wherever hydraulic fluid is used to actuate movable parts of ground support equipment, any desired flexibility can be obtained with Barco Ball Bearing Swivel Joints installed singly or in "dog leg" assemblies in combination with metal tubing or pipe. Wide choice of designs approved for use.



FOR SERVICE PIPING IN PERMANENT LAUNCHING SITE INSTALLATIONS

Widely used to protect vital pipe lines against "shock", up to 50 G's or more, Barco Ball Joints also have broad application in building permanent underground missile facilities where space is limited and service piping must be allowed to expand thermally and also be protected against the shock effects of possible blasts. Choice of sizes ½" to 16".

ASK FOR RECOMMENDATIONS — We invite your inquiry and will be glad to provide engineering recommendations. Industry-wide sales and service. Literature on request:

Catalog 233A—"Flexible Ball Joints for Handling Liquid Oxygen and Missile Fuels."
Catalog 269B—"Plane and Self-Aligning Swivel Joints for Hydraulic Service."
Catalog 215B—"Barco Ball Joints for Flexibility in Piping."
Bulletin 31A—"Ball Joints for Expansion or Contraction in Fixed Piping."

BARCO
BARCO MANUFACTURING CO.
565D Hough Street
Barrington, Illinois

FLEXIBILITY FOR METAL PIPING
Serving Industry Since 1908

Industry Notes

Business Moves

Atlantic Research Corp. has added a Space Vehicles Group to its staff. Team has worked on Project Argus experiments.

Martin's Baltimore Div. is being reorganized. It will include a Martin-Baltimore Electronics Div.

Aerojet-General Corp. has established a new Structural Materials Div.

Lockheed Aircraft Corp., Georgia Div., is operating a new Aerospace Technology Dept.

Bendix Aviation's Missile Section has been established as a separate division of the corporation.

Pratt & Whitney Aircraft is expanding work on developing and manufacturing highly efficient fuel cells.

United Aircraft has formed Corpuscular, A. G., a Swiss firm, to market the Hamilton Zeiss electron beam machine outside the United States and Canada.

Vidya, Inc., subsidiary of Itek Corp., makes available a new Chemistry and Materials Research Div.

Chance Vought Aircraft is expanding activities by acquiring 80 per cent interest in Information Systems, Inc.

ACF Industries merged its Avion and Nuclear Products Divisions into the ACF Electronics Div.

Boeing Airplane Co. and **Vertol Aircraft Corp.** has approved a plan for the acquisition of Vertol by Boeing.

Ryan Aeronautical Co. has acquired **Aerolab Development Co.**

Motorola is acquiring the executive and private aircraft products business of **Lear Inc.**

Lockheed Aircraft is building an avionics research laboratory at Cobb County, Ga. It will study and test antennas and transmission lines. Scaled aircraft models used in radiation pattern measurements will be mounted on plastic towers and operated on three runways extending from the building.

Aeroquip Corp., Marman Div., has completed a new development engineering center.

Ransome Co. has "unmerged" from **Worthington Corp.** It comprises Worthington's old Positioning Equipment Div. The new Ransome Co. is now a wholly-owned division of the Big Three Welding Equipment Co.

Wyle Laboratories has announced expansion of missile-aircraft components testing operations to the East Coast through acquisition of **Parameters Inc.**

Litton Industries has acquired the Electronic Systems Div. of **General Controls Co.**

Chicago Aerial Industries has acquired **Pacific Optical Corp.**

Horkey-Moore Associates has formed a Plastics Div.

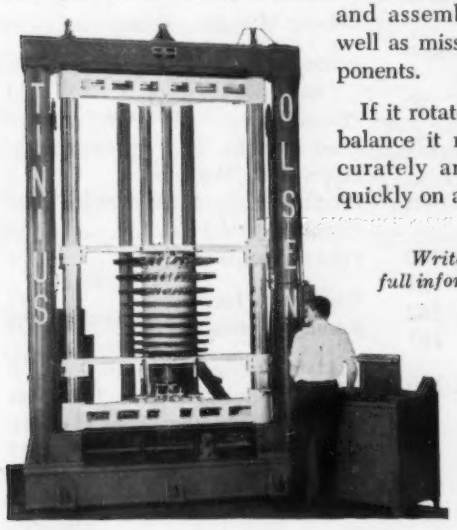
Sperry Gyroscope is testing subseeking systems in simulated sea test basin at Great Neck, L. I. Laboratory nearby will record ocean sounds.

BALANCING JET ENGINES ?

Tinius Olsen offers the most complete line of static *and* dynamic balancing machines for jet engine stages and assemblies, as well as missile components.

If it rotates, you'll balance it more accurately and more quickly on an Olsen.

Write for full information.



TINIUS OLSEN
Testing Machine Co.
2210 Easton Rd. • Willow Grove, Pa.

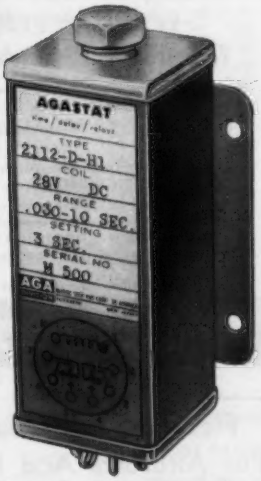
Circle 85 on Inquiry Card

NOW!

MINIATURE AGASTAT®

time/delay/relay

MEASURES ONLY 4"x1½"x1½"



The Miniature Agastat time delay relay is a space-saving answer to aircraft, missile and computer problems. You get all these valuable features in one small package:

- Easily adjusted timing ranges as short as .030 seconds.
- Repeat accuracy of ± 5%.
- Time delay on energizing or de-energizing.
- For DC or AC operation.
- Hermetically sealed or dust-proof housings.

Write today for the full details on the new miniature Agastat. Dept. A36-1122.

AGA DIVISION — ELASTIC STOP NUT CORPORATION OF AMERICA
1027 Newark Avenue, Elizabeth, N. J.

Gasaccumulator Co., (Canada) Ltd., 12 Gower Street, Toronto 16, Ontario

Circle 88 on Inquiry Card

AIRFRAME AND WELDMENTS DIVISION

can do it **now** . . . with speed and accuracy!

Complete fabrication, finishing and weldments of ALL metals . . . for ground handling equipment, towers and prefabricated shelters, warehouses and utility buildings used in the aircraft and missile programs.

CHECK WITH MARTIN
and take advantage of our 50 years of development knowhow aimed at furnishing your requirements economically and efficiently.

MARTIN STEEL CORPORATION • MANSFIELD, OHIO

Circle 87 on Inquiry Card

INFRA-RED OPTICS

DOMES • WINDOWS • LENSES
PRISMS • MIRRORS
To extremely close tolerances

MATERIALS:	
Quartz	Magnesium Oxide
Silicon	Glass
Calcium Aluminate	Strontium Titanate
Sapphire	Metals
Germanium	Arsenic Trisulphide

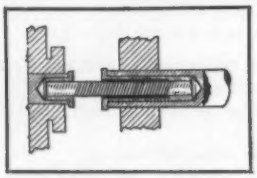
SEND YOUR SPECIFICATIONS FOR IMMEDIATE ESTIMATE

Quick Deliveries—Any Quantity

PRECISION LAPPING Company, Inc.
34 Clinton Ave., Valley Stream, L. I., N. Y. • LOcust 1-2770

Circle 86 on Inquiry Card

Flexible Shaft Coupling For Aircrafts And Missiles



Coupling is used for the transmission of power or control of movement between parts located close together in a piece of equipment. It is not a separate type of flexible shaft but rather an added application of flexible shafting.

The coupling can be composed of either power drive or remote control flexible shafting although the latter is generally used due to the added advantage of its ability to rotate both clockwise and counterclockwise. Generally used between two units which are but a few inches apart, coupling may transmit power between any two parts regardless of their relative positions.

For example, the diagram above shows an advantage in using small lengths of flexible shafting in a coupling application. Although the drive end and the driven end are not exactly in line, the coupling compensates for the difference in alignment between the two.

Many manufacturers use flexible shaft coupling even where parts may be connected by solid shafts because of the savings realized in the initial and the maintenance costs as well as in time and labor.

For complete information on how flexible shaft couplings may help improve your product design, write F. W. Stewart Corporation, 4311-13 Ravenswood Avenue, Chicago 13, Illinois.

Circle 90 on Inquiry Card

ADVERTISERS' INDEX

This Advertisers' Index is published as a convenience, and not as part of the advertising contract. Every care will be taken to index correctly. No allowance will be made for errors or failure to insert.

Ace Drill Bushing Co. 9
Acoustica Associates, Inc. . . . 174
Acra Electric Corp. 136
Aero Publishers 164
Aeronca Mfg. Corp. 114
Aircraft & Missiles Handbook 139
Air Speed Tool Co. 138
Airetool Mfg. Co. 154
AMP Inc. 1
Avco Corp. 25

Barber-Colman Co. 112, 136
Barco Mfg. Co. 176
Bendix Aviation Corp. Products Div. 19
Brooks-Perkins Inc. 151
Brunswick-Balke-Collender Co. . . . . Back Cover
Bulova (Industrial & Defense Sales) 99

Carlson, Inc., G. O. 120
Chicago Rawhide Mfg. Co., . . 2nd Cover
Continental Aviation & Eng. Corp. 100
Convair Instrument Div. 21
Cosa Corp. 162
Custom Tool & Mfg. Co. . . . 101

Dade County Development Co. 136
Defiance Machine & Tool Co. 151
Do-All Co. 10

Eastman Kodak Co. 136
Eastern Machine Screw Co. . . 167
Elastic Stop Nut Corp. of Amer. 177

General Electric Co., G. E. Missiles 16-17
General Mills, Inc. 22-23
Grand Central Rocket Co. . . . 169

Hansen Mfg. Co. 153
Hercules Powder Co. 15
Hokanson Co., Inc. 129
Huck Mfg. Co. 32

Ideal Industries Inc. 138
Ingersoll Kalamazoo Div. . . . 113
Interelectronics Corp. 147

James, Pond & Clark Inc. . . . 167
Jamesbury Corp. 140
Jergens Tool Specialty Co. . . 172

Kelsey Hayes Co. 111
Kohler Co. 145

Latrobe Steel Co. 31
La Vezzi Machine Works . . . 170
Lee Co. 175
Lepel Laboratories, Inc. 168
Lindberg Engineering Co. 156-157

M. C. Mfg. Co. 159
Magnaflux Corp. 173
Martin Steel Corp. 177
Matthews & Co., Jas. H. 3
Midget Louver Co. 168
Motor Generator Corp. 18

National Ultrasonic Corp. . . . 4

Olsen Testing Machine Co., Tinius 177
Osborn Mfg. Co., The 20

Pesco Prod. Div., Borg-Warner Corp. 13
Philco Corp. 122
Pneu Draulics, Inc. 166
Powell Co., William 5
Precision Lapping Co. 178
Premier Metal Prod. Co. 164
Pure Carbonic Co. 121

Rapidesign Inc. 151
Rodney Metals, Inc. 97

Sinclair Collins Valve Co. . . . 6
Sperry Products Inc. . . . 3rd Cover
Springfield Machine Tool Co. 110
Stanpat Co. 127
Steel City Testing Machines . . 168
Stewart Corp., F. W. 178
Sturtevant Co., P. A. 166
Synchro-Start Products Inc. . . 138

Tele Computing Corp. . . . 160-161
Tinsley Laboratories, Inc. . . . 166
Tube Reducing Corp. 24
Tung-Sol Electric, Inc. 135

U. S. Flexible Tubing Co. 170
Ultrasonic Industries Inc. . . . 172

Valvair Div. 6
Vapor Blast Mfg. Co. 170
Vapor Heating Corp. 123
Vascoloy-Ramet Corp. 98
Victor Equipment Co. 137

Washington Steel Corp. 171
Weatherhead Co. 124
Western Alloy Engineering Co., Inc. 159
White Industrial Division, S. S. 163
Wyman-Gordon Co. 14

Free Information for Readers

USE THESE TIME-SAVING POSTAGE PAID REPLY CARDS FOR MORE INFORMATION ON

Advertiser's Products and Services

Copies of Technical Literature

New Materials and Components

New Production Equipment

New Electronic Equipment

and

Employment Opportunities*

Circle the numbers shown in this issue and mail this card for more data on products advertised & described.

***Please use your home address when inquiring about Employment Opportunities.**

USE FREE READER SERVICE CARDS

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **MAR. 1960**

Please send further information on items circled below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180

For the following numbers pertaining to recruitment please use home address.

181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220

YOUR NAME .....TITLE.....

COMPANY .....

PLANT ADDRESS .....

CITY .....ZONE.....STATE.....

PRINCIPAL PRODUCT AT THIS PLANT .....

FIRST CLASS
Permit No. 36
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

Aircraft & Missiles
P. O. Box 74,
Village Station
Readers Service Dept. **New York 14, N. Y.**

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **MAR. 1960**

Please send further information on items circled below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180

For the following numbers pertaining to recruitment please use home address.

181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220

YOUR NAME .....TITLE.....

COMPANY .....

PLANT ADDRESS .....

CITY .....ZONE.....STATE.....

PRINCIPAL PRODUCT AT THIS PLANT .....

Free Information for Readers

USE THESE TIME-SAVING POSTAGE PAID REPLY CARDS FOR MORE INFORMATION ON

USE FREE READER SERVICE CARDS

Advertiser's Products and Services

Copies of Technical Literature

New Materials and Components

New Production Equipment

New Electronic Equipment

and

Employment Opportunities*

Circle the numbers shown in this issue and mail this card for more data on products advertised & described.

*Please use your home address when inquiring about Employment Opportunities.

FIRST CLASS
Permit No. 36
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY

Aircraft & Missiles
P. O. Box 74,
Village Station
Readers Service Dept. New York 14, N. Y.

Postcard valid 8 weeks only. After that use own letterhead fully describing item wanted. **MAR. 1960**

Please send further information on items circled below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180

For the following numbers pertaining to recruitment please use home address.

181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220

YOUR NAME ..... TITLE .....

COMPANY .....

PLANT ADDRESS .....

CITY ..... ZONE ..... STATE .....

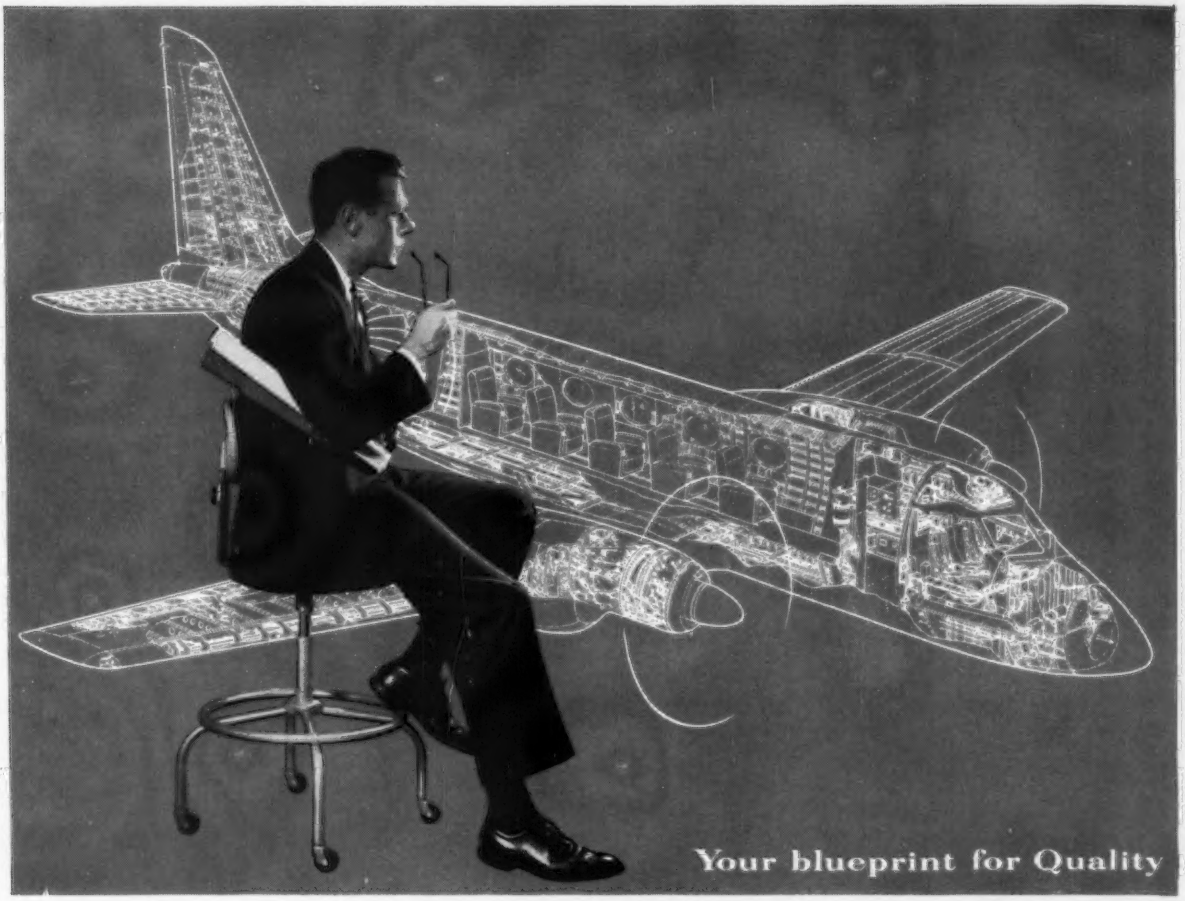
PRINCIPAL PRODUCT AT THIS PLANT .....

FIRST CLASS
Permit No. 36
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY

Aircraft & Missiles
P. O. Box 74,
Village Station
Readers Service Dept. New York 14, N. Y.



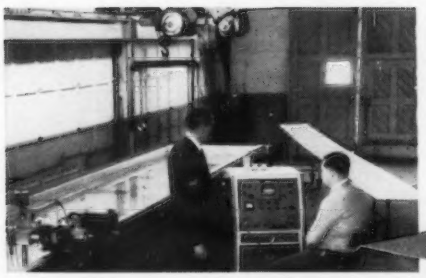
The Man is Sperry Ultrasonics

For years he has collaborated with Grumman's Quality Control Group and engineering personnel in developing ultrasonic test methods and techniques to assure the structural integrity of the material used in carrier-based aircraft.

These nondestructive flaw detection techniques, developed for structures required to withstand rigors of in-fleet service, are now applied to Grumman's new business airplane, the Gulfstream....."built to withstand fatigue for the equivalent of more than fifty years of operation."

Sperry sales engineers are recognized authorities on the application of ultrasonic techniques in nondestructive testing. They are the link that sparks Sperry research and development teams to create the tools to meet your quality control requirements.

When there is a quality control problem, call the man who is Sperry Ultrasonics.



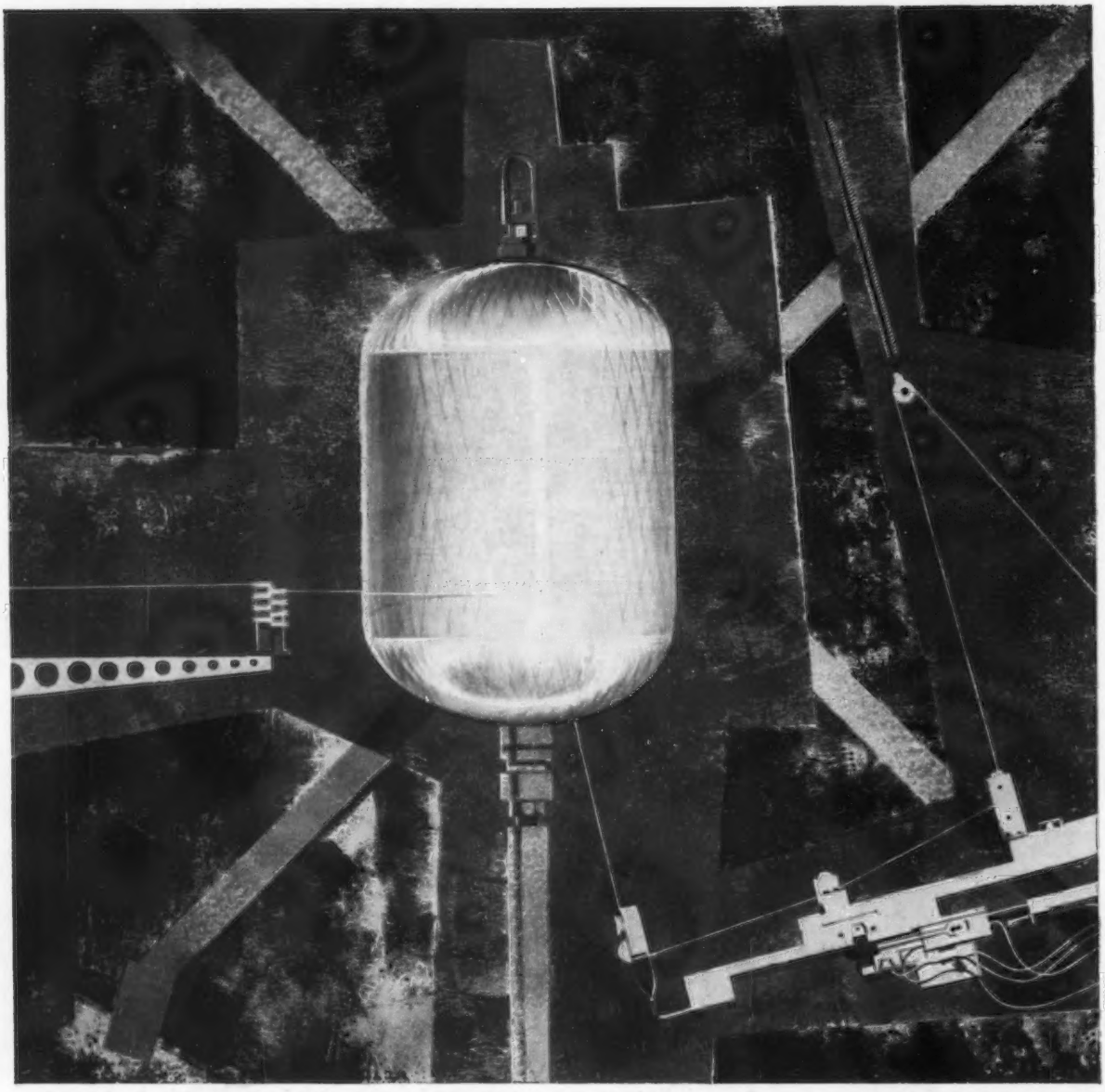
Quality Control Group inspects Gulfstream wingplank section in Grumman Sonic Laboratory.

Sperry Products Company

DIVISION OF HOWE SOUND COMPANY

2803 Shelter Rock Road, Danbury, Connecticut

Circle 2 on Inquiry Card



BRUNSWICK BI-AXIAL WINDING ENCASES ENORMOUS ENERGY!

In the field of rocket motor case construction, Brunswick's exclusive Strickland "B" Process (SBP) of fibre glass filament winding gives an S/D ratio as high as 2,000,000. Engineers are currently calling on Brunswick to provide up to 7,500,000 psi modulus for design allowables. SBP's unique bi-axial winding lays down filaments under tension first in one direction, then in the other (circumferential and longitudinal). As a result, SBP is particularly efficient for construction of closed-end cylindrical shapes and unusually contoured components. Current projects indicate the extremely large range of sizes possible – from 6′ to 12′. Tension winding pre-stresses cases to a rare degree, while allowing precise filament placement for exactly controlled uniformity of thickness and strength. The SBP exclusive automatic control of resin to glass ratio gives Brunswick outstanding uniformity of material composition. From complete in-house design and fabrication to final testing, Brunswick is ready to serve you. Find out more about SBP. Get detailed and documented information on its many unique features. Write or call: Defense Products Division Sales Manager, 1700 Messler Street, Muskegon, Michigan – today!

BRUNSWICK

MAKES YOUR IDEAS *WORK*

Circle 3 on Inquiry Card